Recent Trends in Length of Stay for Medicare Surgical Patients

Christina Witsberger, Gerald Kominski

RAND

The research described in this report was supported by the Health Care Financing Administration, U.S. Department of Health and Human Services, Grant No. 99-C-98489/9.

ISBN: 0-8330-1079-4

Published by The RAND Corporation
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90406-2138

R-3940-HCFA

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August 1990

Supported by the
Health Care Financing Administration,
U.S. Department of Health and Human Services

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PREFACE

Hospital length of stay declined steadily during the 1970s, then rapidly during the early years of the Medicare prospective payment system (PPS). This study examines these trends in hospital length of stay for Medicare patients between 1979 and 1987 for all cases combined, for medical and surgical cases separately, for different geographic regions, for surgical procedures grouped according to organ system, and for the highest-volume surgical procedures. The rate of decline in length of stay varied across procedures but was relatively uniform across geographic regions during this period. The mix of surgical procedures performed on an inpatient basis changed substantially, primarily because of changing technology and greater use of outpatient surgery. The findings should be important to policymakers and researchers interested in changes in use of hospital services by geographic region and by type of procedure.

Reductions in hospital length of stay may also affect the amount of physician services provided to surgical patients. Under Part B of the Medicare program, physicians are paid a "global fee" for their services when performing surgery. This global fee is intended to bundle the physician's compensation for the surgery itself and for pre- and postoperative care associated with the surgery (including additional surgery) into a single, all-inclusive payment. However, the amount of pre- and postoperative services included in the global fee varies by carrier.

If physicians have reduced the number of postoperative hospital visits they provide to Medicare surgical patients in response to reductions in hospital length of stay, changes in global fee payments for surgical cases may be necessary. Recommendations by the Physician Payment Review Commission and the scheduled implementation of a Medicare Fee Schedule for physician payment in January 1992 emphasize the importance of developing a standardized policy for global fees that does not vary by carrier. This report does not address directly the effect of reductions in hospital length of stay on physician services. The study findings, however, combined with results from other recent studies sponsored by the Health Care Financing Administration, may be useful in evaluating the "inherent reasonableness" of global fees for surgical proceduces.

This study was supported by the Health Care Financing Administration, U.S. Department of Health and Human Services.

SUMMARY

Average length of stay for hospital inpatient care declined steadily for Medicare patients from the late 1960s through the early 1980s. The Medicare prospective payment system (PPS), implemented in October 1983, provided strong incentives for hospitals to reduce average length of stay. During the period between 1981 and 1985, average length of stay declined rapidly, with the most rapid change occurring between 1983 and 1985. Since 1985, average length of stay for Medicare hospital inpatients remained relatively constant.

We used two data sources to study recent trends in average length of stay for Medicare patients: the National Hospital Discharge Survey for 1979, 1981, and fiscal year 1984; and Medicare hospital claims files from 1981, and fiscal years 1984 through 1987. We examined trends for all cases combined, for medical compared with surgical cases, for different geographic regions, for surgical procedures grouped according to organ system, and for the 30 highest-volume surgical procedures. These 30 procedures accounted for about two-thirds of all Medicare surgical discharges in fiscal year 1987.

One important issue in evaluating these trends is separating the effect of PPS from other concurrent effects. For example, changes in case mix related to adoption of new technologies and greater use of outpatient treatment for certain surgical procedures are two important factors that have influenced recent trends in average length of stay. In this study, we found that average length of stay was substantially lower among surgical cases after adjusting for changes in the distribution of cases over time.

Length of stay reductions were relatively uniform across geographic regions between 1981 and fiscal year 1987. Large geographic differences in average length of stay in 1981, therefore, were still evident in fiscal year 1987 and have not diminished since the implementation of PPS. The reasons for these geographic differences are not well understood and are the focus of continuing research.

The trends in average length of stay for all Medicare patients between 1979 and fiscal year 1987 fall into three distinct periods. Length of stay declined from 10.5 days in 1979 to 10.2 days in 1981, an average annual rate of 1.4 percent. This was slightly less than the average annual decline of about 1.9 percent throughout the 1970s. Between 1981 and fiscal year 1985, length of stay declined from 10.2 to 8.4 days, an average annual decline of 4.7 percent. Between fiscal

years 1985 and 1987, length of stay increased from 8.4 to 8.5 days, an average annual increase of 0.6 percent. The timing of these declines suggests that they were in response, at least partially, to PPS incentives.

The trends in length of stay for medical and surgical cases were quite different between 1979 and fiscal year 1987. For medical cases, the average annual rate of change was zero from 1979 to 1981, −5.9 percent from 1981 to fiscal year 1985, and −0.7 percent between fiscal years 1985 and 1987. For surgical cases, the average annual rate of change was −4.0 percent from 1979 to 1981, −3.1 percent from 1981 to fiscal year 1985, and +2.4 percent between fiscal years 1985 and 1987.

For medical cases, decreasing average length of stay resulted from a downward shift in the entire distribution of cases by length of stay. For surgical cases, however, length of stay declined despite a reduction in the proportion of cases with stays between one and three days. The decline in short-stay surgical cases supports evidence from other studies that outpatient surgery has increased dramatically under PPS. Surgical cases remained almost constant, however, as a proportion of total Medicare hospitalizations—about 28.5 percent—despite a decrease in total Medicare admissions of almost 10 percent between fiscal years 1984 and 1987.

Changes in case mix had a substantial effect on the average length of stay of surgical cases. After adjusting for case-mix changes, length of stay for surgical cases declined between 1981 and fiscal year 1987 at an average annual rate of between 4.3 and 4.6 percent, depending on the method of case-mix adjustment. This adjusted rate of decline for surgical cases is very similar to the rate of decline for medical cases during this period. Furthermore, between fiscal years 1984 and 1987, the adjusted average annual rate of decline in length of stay was greater for surgical cases than the unadjusted rate for medical cases.

Despite large regional differences in average length of stay in 1981, three of the four major census regions (i.e., the North East, South, and West) experienced about the same percentage decrease in length of stay from 1981 to fiscal year 1987. Length of stay decreased at a somewhat greater rate in the North Central region and in rural hospitals. After adjusting for case-mix change, these regional differences were less pronounced.

Among the 30 highest-volume surgical procedures, decreases in length of stay since 1981 ranged from about 0.5 percent to 8.8 percent per year. Most of these procedures had continuing decreases in length of stay after fiscal year 1984. The five procedures with the greatest average annual decreases in length of stay between 1981 and fiscal year 1987, in decreasing order, were: unilateral inguinal hernia repair,

mastectomy, exploration and decompression of spinal canal structures, knee and ankle arthroplasty, and transurethral prostatectomy.

These results should be important to policymakers and researchers interested in the effect of PPS on use of hospital inpatient days and in practice pattern differences by geographic region and by type of procedure. The results may also be useful, when combined with other recent research efforts, for evaluating payment policy to physicians for surgical proceduces under Part B of the Medicare program.

ACKNOWLEDGMENTS

Grace Carter deserves special thanks for her valuable guidance throughout the course of this study.

We also wish to thank Sally Morton and Sally Trude of The RAND Corporation for their careful reviews of an earlier draft of this report. Any remaining errors, of course, are solely our responsibility.

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I. INTRODUCTION

This study examines changes in hospital length of stay for Medicare patients during the period 1979 to 1987. During the 1970s, hospital length of stay for the Medicare population declined at an average annual rate of 1.9 percent (ProPAC, 1988). Several significant changes in health care delivery and financing during the late 1970s and early 1980s had a substantial effect on the use of hospital inpatient care.

Perhaps the most important factor was the Medicare prospective payment system (PPS), implemented in October 1983. This system of fixed payments based on diagnostic categories provided strong incentives for hospitals to reduce average length of stay. Other concurrent trends, however, also affected the use of hospital inpatient care between 1979 and 1987, including: (1) changes in case mix related to the adoption of new technologies; (2) increasing use of outpatient treatment, especially for surgical patients; (3) PPS incentives to substitute skilled nursing facility care or home health care for hospital inpatient care; (4) increased efforts, after the implementation of PPS, by peer review organizations (PROs) to review the appropriateness of inpatient surgical admissions; and (5) changes in consumer demands on the health care system. We directly examined the effects of changes in case mix and changes in volume for inpatient surgery in this study. A complete understanding of all the above components was beyond the scope of this report, however.

Our analysis begins with overall trends in length of stay and then focuses on trends in length of stay for surgical cases. Trends for surgical cases are of concern to policymakers for several reasons. Surgical cases account for about 30 percent of Medicare hospital admissions but almost 50 percent of payments for hospital inpatient care. The increased use of outpatient surgery has reduced the volume of simple surgical procedures performed on an inpatient basis, whereas technology changes have increased the availability of more complex surgical treatments. Therefore, changes in use of hospital inpatient services by surgical patients are likely to have a substantial effect on Medicare program expenditures.

Reductions in hospital length of stay may also affect the amount of physician services provided to surgical patients. Surgical procedures account for about one-third of total Medicare payments to physicians (Fisher, 1988). Under Part B of the Medicare program, physicians are paid a "global fee" for their services when performing surgery. This

global fee is intended to bundle the physician's compensation for the surgery itself and for pre- and postoperative care associated with the surgery (including additional surgery) into a single, all-inclusive payment. If physicians have reduced the number of follow-up visits they provide to surgical patients in response to reductions in hospital length of stay, changes in global fee payments for surgical cases may be necessary. Analysis of the response of physicians to length-of-stay reductions related to PPS is beyond the scope of this study but has been addressed in a recent study (Rosenbach, 1988).

Using Medicare data, Gornick (1982) showed a slight increase from 1967 to 1977 in the percentage of surgical hospitalizations and a slower rate of decline in average length of stay for surgical than for nonsurgical cases. Other researchers (Sloan and Valvona, 1986; Showstack et al., 1985) have studied length of stay or costs using non-Medicare data on a limited number of surgical operations. These studies found that technology changes have played a significant role in the cost and length of stay of surgical cases. However, our study provides more current and detailed information on longitudinal trends in length of stay for Medicare patients, especially those who undergo surgery.

We examined several aspects of trends in hospital length of stay between 1979 and fiscal year 1987. First, we analyzed trends in overall length of stay for all Medicare patients and for medical and surgical cases separately. Second, we examined geographic differences in length of stay trends for the four major census divisions and for urban and rural areas. Finally, we focused on length-of-stay trends for surgical cases only. In this phase of the analysis, we reexamined overall trends and trends across geographic regions controlling for changes in case mix. We also studied trends for surgical procedures grouped according to organ systems and for the 30 highest-volume surgical procedures.

The next section of this report describes the data sources and methods used in this study. Section III presents the research results. Section IV presents the study conclusions and discusses potential policy implications.

II. DATA SOURCES AND METHODS

DATA SOURCES

We used two sources of data for our analysis—the National Hospital Discharge Survey (NHDS) for 1979, 1981, and fiscal year 1984, and Medicare hospital claims from the Health Care Financing Administration (HCFA) for 1981 and federal fiscal years 1984 through 1987.

The NHDS, initiated in 1964, is conducted yearly by the National Center for Health Statistics. It contains demographic and medical information abstracted from hospital medical records for a sample of nonfederal, short-stay hospitals in 50 states and the District of Columbia. Approximately 200,000 to 250,000 patient records are abstracted each year from about 400 hospitals. Patients are selected randomly within hospitals, so both Medicare and non-Medicare patients are included. Hospitals are stratified by number of beds, ownership, and geographic region. The data files include sampling weights for each record that can be used to produce national estimates. They also include information on payment source and up to four procedure codes.

The HCFA data sources included the Medicare Provider Analysis and Review (MEDPAR) file for calendar year 1981, and the Patient Billing (PATBILL) files for federal fiscal years 1984 through 1987. Each file contains a 20 percent sample of all Medicare acute care hospital discharges from 50 states and the District of Columbia. The files for fiscal years 1984 through 1986 were created from bills received approximately 1½ to 2 years after the fiscal year closing date (i.e., September 30), so they can be considered virtually complete. The fiscal year 1987 file was created from bills received as of July 1988, i.e., only nine months after the close of the fiscal year. Therefore, it may underestimate the number of cases with long lengths of stay. The 1981 MEDPAR file has only one procedure code on it, whereas the PATBILL files have up to three procedures. Throughout the remainder of this report, we will refer to both the MEDPAR and PATBILL data bases as HCFA files.

We chose 1979 as the first point in our time series because the *International Classification of Diseases, 9th Edition, Clinical Modification* (ICD-9-CM) coding system was implemented starting in 1979. Therefore, from 1979 through 1987, the same coding system was used

to identify surgical procedures in both the NHDS and HCFA files.[1] The NHDS is a valuable source of baseline (i.e., pre-PPS) time series data on Medicare hospital use by procedure code because hospitals were not required to report procedure codes to HCFA using ICD-9-CM codes until 1982. Furthermore, because the 1981 MEDPAR file only has one procedure code, it is a less reliable source of data for surgical procedures than later HCFA files.

METHODS

Data Base Construction

We selected all cases from the NHDS files with Medicare listed as a source of payment. During preliminary data exploration we examined the age distribution in these records and found two sources of error. First, the source of payment variable appeared to have discrepancies for children and young adults. For example, there were an excessive number of births coded as Medicare payment, so it appeared that Medicaid payment was sometimes coded as Medicare. Second, because the NHDS does not collect information on the century of birth, young children could not be distinguished from persons 100 years of age or older (99 is the maximum age in the data). Therefore, in our final sample, we selected cases with Medicare as a payment source for patients who were between the ages of 20 and 99 and who did not have a pregnancy or delivery-related diagnosis. We used the NHDS data primarily to substitute for missing or unreliable HCFA data before fiscal year 1984. We created a fiscal year 1984 NHDS file from the 1983 and 1984 yearly files to overlap with the fiscal year 1984 HCFA data. Our final unweighted sample sizes were: 53,249 (1979), 60,356 (1981), and 57,914 (fiscal year 1984).

Surgical and medical cases were defined using Diagnosis-Related Groups (DRGs).[2] The HCFA files and the fiscal year 1984 NHDS file

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[1]Information on length of stay for surgical procedures before 1979 is available in the Series 13 reports issued by the National Center for Health Statistics. These reports contain detailed information by procedure and age group for 1965, 1968, 1971, 1973, 1975, and 1978. Before 1979, surgical procedures were recorded in the NHDS using a modification of the *International Classification of Diseases, Eighth Edition, Adapted* coding system. Because of some significant changes between this coding system and ICD-9-CM, trends for specific procedure codes before 1979 may not be meaningful.

[2]Surgical DRGs have at least one procedure code defined as an operating room procedure. In fiscal year 1986, the definition of operating room procedures used in DRG assignment changed slightly. The following procedure codes were added to the list of operating room procedures: 68.13 (uterine biopsy), and 70.76 (hymenorrhaphy). The following procedure codes were deleted from the list of operating room procedures: 37.86

included a DRG assignment for each case. Almost all DRGs are defined as either surgical or medical. Therefore, we identified medical and surgical cases based on DRG assignment and excluded cases in DRGs that are not defined as strictly medical or surgical.[3] The 1979 and 1981 NHDS files did not include DRG assignment, so we identified surgical cases in those files in the following way. We used the list of operating room procedures from the fiscal year 1984 GROUPER program, which was used by HCFA for DRG assignment in fiscal year 1984, and identified patients as surgical cases if they had at least one procedure code defined as an operating room procedure.

We also deleted from our HCFA files any record with an unrecognizable primary procedure code, because the GROUPER software will classify these patients into a medical DRG if their diagnosis codes are valid. For fiscal year 1984 through fiscal year 1987, these deletions accounted for only about 1 percent of the bills. However, because of the poor quality of the diagnosis and procedure coding on the 1981 MEDPAR file, about 6 percent of the bills were deleted. There were no invalid procedure codes in the NHDS files.[4]

Table 1 lists descriptive statistics for our final analytical files. In general, the two data sources are very comparable in age, sex, and average length of stay. The only apparent discrepancy is the average length of stay for surgical cases, which is about one-half day longer in the NHDS in 1981. Because this difference is statistically significant ($p < 0.001$), we examined several possible sources for this difference. First, we adjusted the sampling weights in the 1981 NHDS to match the region, number of beds, and ownership proportions in the 1981 HCFA file. Then, we calculated the average length of stay for the cases deleted from the 1981 HCFA file. Neither of these adjustments

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(pacemaker removal), 39.61 (pump oxygenator), 39.96 (total body perfusion), 51.96 (percutaneous extraction of duct stones), 54.99 (abdominal region operation, not elsewhere classified), and 86.23 (nail removal). We classified records as they were actually coded, except for code 37.86, which we classified as a surgical procedure in all years, because it was returned to the list of operating room procedures in fiscal year 1988. These procedure codes accounted for an extremely small number of cases in our files, with the exception of 86.23, which was the primary procedure for 900 cases in the fiscal year 1984 HCFA file. Our aggregate statistics, therefore, have very slight differences in the definition of surgical patients between years. To maintain comparability in our analyses of procedure groups and high-volume procedures, we excluded the procedure codes discussed above, except 37.86.

[3]The following DRGs were excluded using this criterion: 385–391, 433–438, 456–457, 469, and 470. These DRGs accounted for less than 0.75 percent of Medicare cases in fiscal year 1984 and for an even smaller proportion of total cases in later years.

[4]The Institute of Medicine (IOM) conducted studies on the quality of the NHDS and Medicare data. These studies found that the primary procedure was coded accurately in about 75 percent of surgical cases (IOM, 1977 and 1980). These studies were performed using 1977 NHDS and 1974 Medicare data.

Table 1

COMPARISON OF DATA SOURCES

	Thousands of Cases[a]	Av. LOS	Av. Annual % Change in LOS[b]	Av. Case-Mix Index[c]	Av. Age	Proportion of Cases			
						Died	Male	Age <65	Age 85+
Medical Cases									
NHDS data									
1979	1,442	9.7	—	NA	72.7	.08	.44	.14	.13
1981	1,621	9.6	−0.5	NA	73.0	.08	.44	.13	.13
FY84	1,719	8.4	−4.5	0.97	73.7	.07	.43	.11	.14
HCFA data									
1981	1,455	9.7	—	0.92	73.1	.06	.45	.12	.13
FY84	1,532	8.3	−5.0	0.95	73.6	.07	.44	.11	.14
FY85	1,394	7.6	−8.6	0.96	73.9	.07	.44	.11	.15
FY86	1,388	7.4	−1.7	0.93	73.9	.07	.44	.11	.15
FY87	1,354	7.5	1.1	0.93	74.0	.08	.43	.11	.16
Surgical Cases									
NHDS data									
1979	532	12.8	—	NA	72.2	.04	.47	.11	.09
1981	624	12.3	−1.9	NA	72.4	.03	.47	.10	.09
FY84	710	10.5	−5.0	1.59	72.8	.04	.46	.09	.10
HCFA data									
1981	458	11.8	—	1.48	72.5	.03	.47	.10	.09
FY84	622	10.5	−3.8	1.57	72.9	.03	.47	.09	.10
FY85	553	10.4	−0.7	1.72	72.8	.04	.48	.10	.10
FY86	551	10.8	3.5	1.94	72.7	.04	.49	.10	.10
FY87	558	10.9	0.6	1.98	72.8	.04	.50	.09	.10

SOURCES: NHDS (1979, 1981, 1983, and 1984), and HCFA (1981 MEDPAR and FY84–FY87 PATBILL files).

[a]All frequencies are weighted to be equivalent to a 20 percent sample of Medicare discharges. The average case weights in the NHDS were 37 in 1979 and 1981, and 42 in FY84.

[b]The average annual percentage change in mean length of stay (LOS) from the previously listed year.

[c]Average DRG relative weight per case, based on DRG relative weights in effect under PPS. For 1981, FY84 relative weights were used.

NA = not available.

reduced the difference in length of stay for surgical patients, so we were unable to explain the remaining discrepancy.[5]

ANALYTIC TECHNIQUES

To eliminate the effect of extreme outliers, we truncated length of stay at 100 days for all cases (i.e., all records with values greater than 100 were set to 100). This was the 99.9th percentile of the distribution in both the HCFA and NHDS files. For analyses using HCFA data, we used the entire 20 percent sample for surgical cases and a 5 percent sample for medical cases. For analyses using the NHDS data, we adjusted the sample weights to produce frequencies comparable to the 20 percent HCFA sample.

We used the primary surgical procedure during the hospital stay in our analyses of specific surgical procedures and procedure groups. We defined the primary procedure as the first-listed operating room procedure code.[6]

The ICD-9-CM coding system for procedures has three levels of detail. The first two digits of the procedure code indicate the organ system (e.g., breast procedures); the third digit describes the surgery performed (e.g., mastectomy). Many procedure codes also have a fourth digit that provides a final level of specificity (e.g., total hip replacement using methyl methacrylate).

We analyzed surgical procedure groups based on ICD-9-CM codes aggregated into body systems (i.e., at the two-digit level). We analyzed the 30 highest-volume procedures defined at the three-digit level. We believe this level of coding gave the best balance between clinical specificity and adequate sample size, especially in the NHDS data.[7]

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[5]Other researchers have also found that the NHDS typically has a slightly longer length of stay than Medicare data (Lubitz, 1981). The discrepancy in our 1981 data is smaller than reported in other studies.

[6]In both the NHDS and the PATBILL files, about 93 percent of the surgical cases had an operating room procedure listed as the first procedure code. Only about 2 percent of the cases did not have an operating room code listed until the third procedure code. The 1981 MEDPAR file has only one procedure code per patient.

[7]Using the four-digit level of specificity could also bias the results because of substantial changes in the use of the fourth digit over time in the HCFA files. Before PPS, many of the four-digit procedure codes were used to record procedures defined as "not otherwise specified" or "other." This lack of clinical specificity changed dramatically after the implementation of PPS. For example, for procedure 36.1x (i.e., codes 36.10–36.19, coronary artery bypass), 48 percent of the cases in 1981 were coded as 36.10 (not otherwise specified), whereas less than 1 percent were coded this way in fiscal year 1987. This phenomenon was observed for most procedures.

For procedure code 79.3x (open reduction of fracture with internal fixation), we used the four-digit code that accounted for the most cases, femur fractures (79.35), because the three-digit level was too general. This group also had coding problems in 1981, when 40 percent of cases were in the "unspecified" bone category versus less than 1 percent in

We found some major inconsistencies between the NHDS and HCFA data files in the frequencies of certain procedures for the same year. Therefore, for our analysis of the 30 highest-volume procedures, we examined how often each procedure was the first-listed surgical procedure compared to the total number of times it occurred. We also compared the average length of stay for all cases with the procedure compared to first-listed cases. We defined procedures as having classification problems if: (1) They were not the primary surgery (i.e., the first-listed operating room procedure) at least 75 percent of the time; or (2) the difference in average length of stay between cases having the procedure as the first-listed procedure and all cases having the procedure was greater than 15 percent. These procedures, and a description of their classification problems, are listed in Appendix A.

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fiscal year 1987. However, the percentage change in length of stay was the same for femur fractures as for the group classified at the three-digit level.

III. RESULTS

OVERALL TRENDS

Average length of stay was at its peak for Medicare patients in 1967 at 13.4 days. It declined to about 11 days in 1975, an average annual rate of about 2.8 percent.[1] Between 1975 and 1981, average length of stay decreased at the much slower average annual rate of about 1.1 percent (Office of Technology Assessment, 1985, p. 38; Guterman and Dobson, 1986, p. 103).

Our analysis shows that average length of stay for all Medicare patients declined from 10.2 days in 1981 to 8.5 days in fiscal year 1987, as shown in Table 2. This represents a 16.5 percent total decrease and an average annual decrease of 3.0 percent. This annual rate of decline was much greater than the rate of decline from 1975 to 1981. The average annual decline was even greater between 1981 and fiscal year 1985. Data from other sources (ProPAC, 1988, p. 26; Guterman and Dobson, 1986, p. 103) indicate that most of the decline during this period occurred between 1982 and 1984.

MEDICAL COMPARED WITH SURGICAL CASES

The total decline in average length of stay was much greater for medical than for surgical cases between 1981 and fiscal year 1987. Furthermore, length of stay for surgical cases began to increase after fiscal year 1985. This increase among surgical cases offset the continued decline among medical cases and produced a relatively constant overall length of stay.

Average length of stay declined almost two times faster for medical cases than for surgical cases between 1981 and fiscal year 1985. This difference between medical and surgical cases is slightly greater than estimates from earlier periods. One study found that average length of stay decreased about 1.5 times faster for medical cases than for surgical

[1]Average annual changes in length of stay were calculated using the following formula:

$$\text{Average annual change in LOS} = (1 + r)^{(1/N)}$$

where r = total percentage change in LOS between two time periods, and
N = number of years between time periods.

Table 2

OVERALL TRENDS IN LENGTH OF STAY

Year	Thousands of Cases[a]	Percent Surgical	Average Length of Stay		
			Total	Medical	Surgical
1979	1,974	27	10.5	9.7	12.8
1981	1,913	24	10.2	9.7	11.8
FY84	2,154	29	8.9	8.3	10.5
FY85	1,948	28	8.4	7.6	10.4
FY86	1,938	28	8.4	7.4	10.8
FY87	1,912	29	8.5	7.5	10.9
Percent change:		Total 1981–FY87	−16.5	−22.2	−8.0
		Average annual:			
		1981–FY87	−3.0	−4.1	−1.4
		1981–FY85	−4.7	−5.9	−3.1
		FY85–FY87	+0.6	−0.7	+2.4

SOURCES: NHDS (1979); HCFA (1981 MEDPAR, FY84–FY87 PATBILL files).

[a]All frequencies are weighted to equal a 20 percent sample of hospital stays.

cases from 1967 to 1977 (Gornick, 1982, p. 50). The increase in length of stay for surgical cases since fiscal year 1985 is the first increase among Medicare cases since the implementation of the Medicare program.

Changes in length-of-stay distributions were very distinct for medical and surgical cases, as shown in Table 3. The proportion of cases with stays over two weeks decreased from 17.9 to 10.0 percent for medical cases, and from 27.4 to 21.9 percent for surgical cases, between 1981 and fiscal year 1987. For medical cases, the proportion of cases with stays of three days or less increased from 21.8 to 27.8 percent during this period. Surgical cases with one-day stays also increased during this period. Surgical cases with two- and three-day stays declined, however. The substantial change in the proportions of short-stay surgical cases is consistent with an increase in outpatient surgery during this period.[2]

[2]There is no evidence that the slight increase in in-hospital death rates during this period, shown in Table 1, affected length of stay. A previous study reported that deaths accounted for one-third of all one-day hospital stays for the aged Medicare population in 1977 (Gornick, 1982, p. 55). Deaths accounted for only about 6 percent of the one-day stays for surgical cases in both the 1981 and fiscal year 1987 HCFA files, however.

Table 3

DISTRIBUTION OF CASES BY LENGTH OF STAY
(In percent)

Length of Stay	1979	1981	FY84	FY87
	Medical Cases			
1 day	5.8	5.2	6.4	7.3
2 days	7.2	7.9	9.3	9.7
3 days	8.4	8.7	10.2	10.8
4–5 days	17.1	17.2	19.7	21.1
6–7 days	14.6	14.5	15.5	16.1
8–10 days	16.0	16.0	15.5	15.4
11–14 days	12.9	12.5	10.7	9.6
15–21 days	9.9	9.8	7.3	6.0
22–28 days	3.8	3.8	2.6	2.1
29–42 days	2.8	2.7	1.7	1.2
43 days and over	1.5	1.6	1.1	0.7
Median	6.6	6.5	5.6	5.1
Mean	9.7	9.7	8.3	7.5
	Surgical Cases			
1 day	2.3	2.4	4.7	5.7
2 days	8.2	11.4	14.9	7.0
3 days	8.5	10.0	8.0	7.1
4–5 days	13.5	12.8	12.2	14.5
6–7 days	9.7	9.8	10.4	12.2
8–10 days	13.6	13.2	13.8	16.8
11–14 days	13.7	12.9	13.3	14.9
15–21 days	14.7	13.8	12.2	11.9
22–28 days	7.3	6.2	4.8	4.5
29–42 days	5.3	4.5	3.5	3.3
43 days and over	3.2	2.9	2.2	2.2
Median	8.6	7.7	7.0	7.6
Mean	12.8	11.8	10.5	10.9

SOURCES: NHDS (1979); HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).

The mean and the median lengths of stay for medical cases declined by almost the same amount between 1981 and fiscal year 1987. These declines were almost identical because of the overall shift in the distribution of medical cases toward shorter stays. For surgical cases, how-

ever, the mean length of stay declined much more than the median. This difference occurred because of a reduction in both short-stay and long-stay surgical cases.

The greatest increases were for surgical cases with stays of 8–10 days and for medical cases with stays of 4–5 days. The trends in all length-of-stay intervals were consistent over time, except for surgical cases with two-day stays. These cases increased between 1981 and fiscal year 1984, then decreased substantially.[3]

GEOGRAPHIC VARIATIONS

Table 4 shows the large differences in length of stay between the four major census regions and between urban[4] and rural areas in 1981. The trends in length of stay indicate that all regions experienced about the same percentage decrease from 1981 to fiscal year 1987, with the exception of the North Central region. The average annual decline in length of stay for medical cases was very similar in urban and rural areas. Length of stay for surgical cases, however, declined much more rapidly in rural areas than in urban areas.

Between 1981 and fiscal year 1985, the national average annual rate of decline in length of stay was 5.9 percent for medical cases and 3.1 percent for surgical cases (see Table 2). For medical cases, there were large geographic differences in the annual rate of decline, most notably between the North East and North Central regions. For surgical cases, there were large differences between the North Central and other regions and between urban and rural areas.

Since fiscal year 1985, length of stay for surgical cases has increased across all geographic regions. Length of stay for medical cases remained relatively stable across census regions between fiscal years 1985 and 1986, except in the North East, where it declined substantially. This large decline in the North East was responsible for continued declines in the national average length of stay for both urban and rural areas.

Length of stay for medical cases increased after fiscal year 1986 in all four census regions and in urban and rural areas. Only the North

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[3]The large increase between 1981 and fiscal year 1984 for two-day surgical stays also occurred in the NHDS data.

[4]Cases were assigned to geographic areas on the basis of where they were hospitalized. Urban areas are defined as counties included in a Metropolitan Statistical Area (MSA) in fiscal year 1987. Rural areas are all counties not included in an MSA.

Table 4

GEOGRAPHIC VARIATION IN AVERAGE LENGTH OF STAY

Year	Rural	Urban	North East	North Central	South	West
			Medical Cases			
1981	8.2	10.2	11.8	9.9	8.9	8.0
FY84	7.0	8.8	10.7	8.0	7.6	6.7
FY85	6.4	8.0	9.9	7.1	7.0	6.1
FY86	6.3	7.8	9.2	7.1	7.1	6.1
FY87	6.5	7.9	9.3	7.2	7.2	6.2
Change 81 to 87:						
Total	−21.5%	−22.9%	−21.5%	−27.6%	−19.1%	−22.7%
Av. Ann.	−4.0%	−4.3%	−4.0%	−5.2%	−3.5%	−4.2%
Change 81 to 85:						
Total	−22.0%	−21.6%	−16.1%	−28.3%	−21.3%	−23.8%
Av. Ann.	−6.0%	−5.9%	−4.3%	−8.0%	−5.8%	−6.6%
Change 85 to 87:						
Total	1.6%	−1.2%	−6.1%	1.4%	2.9%	1.6%
Av. Ann.	0.8%	−0.6%	−3.1%	0.7%	1.4%	0.8%
			Surgical Cases			
1981	10.8	12.0	13.5	12.4	11.2	9.5
FY84	9.2	10.8	12.4	10.5	10.1	8.8
FY85	9.0	10.7	12.1	10.3	10.2	8.8
FY86	9.3	11.1	12.7	10.6	10.6	8.9
FY87	9.3	11.2	12.8	10.6	10.7	9.0
Change 81 to 87:						
Total	−13.9%	−7.0%	−4.8%	−14.5%	−4.9%	−5.6%
Av. Ann.	−2.5%	−1.2%	−0.8%	−2.6%	−0.8%	−1.0%
Change 81 to 85:						
Total	−16.7%	−10.8%	−10.4%	−16.9%	−8.9%	−7.4%
Av. Ann.	−4.5%	−2.8%	−2.7%	−4.5%	−2.3%	−1.9%
Change 85 to 87:						
Total	3.3%	4.7%	5.8%	2.9%	4.9%	2.3%
Av. Ann.	1.7%	2.3%	2.9%	1.4%	2.4%	1.1%

SOURCE: HCFA (1981 MEDPAR and FY84–FY87 PATBILL files).

East region, which continued to have the highest average length of stay, had a decline in length of stay for medical cases between fiscal years 1985 and 1986. This result is particularly interesting for the following reason. Two states in this region (New York and Massachusetts) had waivers that exempted them from PPS before fiscal year 1986, but both allowed their waivers to expire and began receiving PPS payments during fiscal year 1986. Therefore, hospitals in these states were subject to PPS incentives to reduce length of stay for the first time during fiscal year 1986.

Our findings indicate that geographic differences in average length of stay have not diminished. Average length of stay varied considerably across census region and between urban and rural areas in 1981. These differences remained in fiscal year 1987.

For medical cases, average length of stay was 24.4 percent higher in urban areas than in rural areas in 1981. By fiscal year 1987, the difference between urban and rural areas was 21.5 percent. Likewise, the difference in average length of stay for medical cases between the highest and lowest census regions was 47.5 percent in 1981 and 50.0 percent in fiscal year 1987.

For surgical cases, average length of stay in urban areas was 11.1 percent higher than in rural areas in 1981 and 20.4 higher in fiscal year 1987. The difference in length of stay between the highest and lowest census region remained relatively constant at about 42.1 percent between 1981 and fiscal year 1987.

EFFECT OF CHANGING CASE MIX

Medicare discharges were highest in fiscal year 1984 and have declined steadily since then, as shown in Table 2. Another study found that Medicare admission rates reached their peak in fiscal year 1983 (Office of Technology Assessment, 1985, p. 41). One important reason for the decline in hospital admissions has been the increased use of outpatient surgery for relatively simple procedures (ProPAC, 1989, pp. 47–50). The percentage of inpatient surgical cases, however, has remained relatively constant at between 28 and 29 percent, despite this increase in outpatient surgery.[5] Because the proportion of inpatient surgical cases remained constant whereas their average length of stay

[5]We deleted a large number of cases from the 1981 MEDPAR file because of bad coding. We estimate that between one-third and one-half of the deleted cases were surgical. If these cases had not been deleted, our total sample would have been 2,029,000 and the proportion of surgical cases would have been between 24 and 26 percent. In the 1981 NHDS file, 28 percent of the cases were surgical.

increased, we examined the effect of changing case mix on length of stay trends for surgical cases.[6]

The trends in length of stay for surgical cases overall and by geographic region, holding case mix constant, are shown in Table 5. In contrast to the results in Tables 2 and 4, length of stay for surgical cases continued to decline after fiscal year 1984 when adjusting for case-mix changes. The adjusted average annual decline for surgical cases is slightly greater than the decline for medical cases shown in Table 2.

The large differences in average annual changes in length of stay between census regions and between urban and rural areas also diminished when adjusting for case-mix change. For example, the unadjusted rate of decline for rural areas was about 100 percent greater than the rate for urban areas, whereas the adjusted rate was only about 20 percent greater. Length of stay continued to decline in all four census regions and in both urban and rural areas. The findings in Table 5 indicate that the unadjusted trends in length of stay were affected substantially by changes in the mix of inpatient surgical procedures.

The geographic differences in average length of stay for surgical cases were still evident in fiscal year 1987, even after adjusting for changes in case mix. Holding case mix constant at fiscal year 1987 levels, the difference in length of stay between urban and rural areas was 10.6 percent in 1981 and 16.0 percent in fiscal year 1987. Both of these percentages are smaller than the unadjusted differences calculated using data in Table 4. The adjusted difference between the highest and lowest census regions was 39.0 percent in 1981 and 47.0 percent in fiscal year 1987.

Average length of stay and inpatient volume were inversely related between 1981 and fiscal year 1987 among the highest-volume surgical procedures, as shown in Table 6. Procedures with the lowest average length of stay in 1981 (e.g., less than eight days) had large volume declines. The most notable examples are: lens procedures (13.4, 13.7, and 13.1), dilatation and curettage (69.0), and hernia procedures (53.0

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[6]We adjusted for changes in surgical case mix in the following way:

$$\text{ALOS}_y \mid \text{CM}_t = \sum_{i=1}^{n} p_{i,t}\ \text{ALOS}_{i,y}$$

= average length of stay in year y holding case mix constant in year t,

where $p_{i,t}$ = proportion of surgical cases with procedure i holding case mix constant in year t, and

$\text{ALOS}_{i,y}$ = average length of stay for procedure i in year y .

Table 5

AVERAGE LENGTH OF STAY FOR SURGICAL CASES
HOLDING CASE MIX CONSTANT

Year	Actual LOS	LOS Using Case Mix from: 1981	FY84	FY87
Total				
1981	11.8	11.8	12.2	14.4
FY84	10.5	10.5	10.5	12.4
FY87	10.9	9.1	9.4	10.9
Change 81 to 87:				
Total	−8.0%	−23.2%	−23.3%	−24.7%
Av. Ann.	−1.4%	−4.3%	−4.3%	−4.6%
Rural				
1981	10.8	10.8	11.1	13.2
FY84	9.2	9.1	9.4	11.1
FY87	9.3	7.9	8.2	9.5
Change 81 to 87:				
Total	−13.9%	−26.4%	−26.5%	−27.7%
Av. Ann.	−2.5%	−5.0%	−5.0%	−5.3%
Urban				
1981	12.0	12.0	12.4	14.6
FY84	10.8	10.7	10.7	12.7
FY87	11.2	9.3	9.6	11.1
Change 81 to 87:				
Total	−7.0%	−22.2%	−22.6%	−24.1%
Av. Ann.	−1.2%	−4.1%	−4.2%	−4.5%
Northeast				
1981	13.5	13.5	13.8	16.4
FY84	12.4	12.6	12.5	14.8
FY87	12.8	10.8	11.2	13.1
Change 81 to 87:				
Total	−4.8%	−20.0%	−19.3%	−20.0%
Av. Ann.	−0.8%	−3.7%	−3.5%	−3.6%
North Central				
1981	12.4	12.3	12.7	14.9
FY84	10.5	10.4	10.6	12.5
FY87	10.6	8.9	9.2	10.6
Change 81 to 87:				
Total	−14.5%	−27.9%	−27.3%	−29.0%
Av. Ann.	−2.6%	−5.3%	−5.2%	−5.6%
South				
1981	11.2	11.4	11.8	13.9
FY84	10.1	10.0	10.2	12.1
FY87	10.7	9.1	9.3	10.7

Table 5—continued

Year	Actual LOS	LOS Using Case Mix from: 1981	FY84	FY87
Change 81 to 87:				
Total	−4.9%	−20.5%	−21.0%	−23.4%
Av. Ann.	−0.8%	−3.7%	−3.8%	−4.3%
West				
1981	9.5	9.6	10.0	11.8
FY84	8.8	8.4	8.5	10.1
FY87	9.0	7.5	7.6	8.9
Change 81 to 87:				
Total	−5.6%	−21.3%	−23.5%	−24.9%
Av. Ann.	−1.0%	−3.9%	−4.4%	−4.7%

SOURCE: HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).

and 53.9). Procedures with the highest average length of stay in 1981 (e.g., more than 15 days) had large volume increases. Some of the largest increases were: coronary bypass (36.0 and 36.1), hip replacement (81.5), knee and ankle arthroplasty (81.4), and wound debridement (86.2).

PROCEDURE GROUPS BY ORGAN SYSTEM

Volume and length of stay statistics for procedures grouped by organ system are shown in Table 7. Similar statistics using NHDS data for the period 1979 through fiscal year 1984 are presented in Appendix B.

The following procedure groups had average annual increases in length of stay ranging from 0.1 percent to 11.4 percent:

04	Cranial and Peripheral Nerves
08	Eyelids
16	Orbit and Eyeball
30	Excision of Larynx
31	Larynx and Trachea—operations other than excision
52	Pancreas
67	Cervix
69	Uterus and Supporting Structures
86	Skin and Subcutaneous Tissue

In many of these groups, length of stay appears to have increased because of increased use of outpatient surgery. This increase has probably occurred because only the most seriously ill patients are treated as inpatients. We were not able to study this hypothesis directly, however. Procedures in the above groups that have experienced large decreases in hospitalization are: carpal tunnel release (04), lens procedures (16), cervical conizations and biopsies (67), dilatation and curettage (69), and excision or destruction of larynx tissue or lesions (30).

The increase in length of stay for skin procedures (86) is due to a large increase in the proportion of cases with wound debridement (from 22 percent in 1981 to 57 percent in fiscal year 1987). Larynx and trachea procedures other than excisions (31) and pancreas procedures (52) also had large increases in admissions. However, the procedures accounting for the majority of cases in these groups in fiscal year 1987 (permanent tracheostomies, and pancreatotomies and pancreatectomies, respectively) had little change in length of stay.

The five procedure groups with the greatest average annual decreases in length of stay from 1981 to fiscal year 1987, ranging from −9.3 percent to −7.9 percent, were:

05	Sympathetic Nerves and Ganglia
09	Lacrimal System
11	Cornea
26	Salivary Glands and Ducts
63	Spermatic Cord, Epididymis, Vas Deferens

The procedures accounting for the majority of cases in these groups are relatively simple: lumbar sympathectomy (05); dacryocystorhinostomy (09); corneal transplants (11); excision of lesions and sialoadenectomy (26); and excisions of cysts, varicocele, and hydrocele (63). These procedures are also being shifted to outpatient settings. The cases that are treated on an inpatient basis, however, have shorter stays in fiscal year 1987. These patients may be more severely ill but still require fewer days of hospital care than in 1981.

Four of the five procedure groups with declining length of stay also had decreasing volumes between fiscal years 1984 and 1987. There was no clear relationship between volume and length of stay for procedure groups with increasing length of stay.

All procedure groups with declining length of stay had decreases from 1981 to fiscal year 1984 and from fiscal year 1984 to fiscal year 1987. For procedure groups with increasing length of stay, however,

Table 6

FORTY HIGHEST FREQUENCY PROCEDURE CODES BY LENGTH OF STAY IN 1981

Procedure Code	Frequency Rank			Average LOS			Percentage of Cases		
	1981	FY84	FY87	1981	FY84	FY87	1981	FY84	FY87
13.4	26	19	129	2.6	2.1	2.3	0.7	1.1	0.1
13.7	6	18	179	2.9	2.3	2.2	3.2	1.2	0.1
13.5	12	2	21	3.0	2.3	2.5	1.8	6.5	1.0
13.1	1	3	98	3.7	2.7	3.1	8.7	4.1	0.2
04.4	31	40	99	4.4	4.0	4.5	0.7	0.5	0.2
69.0	20	24	57	4.9	4.3	5.4	1.2	0.8	0.3
77.5	33	29	55	6.0	4.5	3.3	0.6	0.7	0.4
14.4	46	44	34	6.2	4.8	3.5	0.4	0.5	0.6
85.2	34	33	40	6.3	5.2	5.1	0.6	0.6	0.5
53.0	5	6	6	6.7	5.4	3.8	3.4	3.2	2.7
85.1	28	45	102	7.0	6.2	6.9	0.7	0.4	0.2
57.4	10	10	14	7.3	6.2	5.5	1.8	2.0	1.9
37.8	47	39	35	7.5	6.4	6.2	0.4	0.5	0.6
53.9	22	235	273	7.9	12.0	11.7	0.9	0.0	0.0
49.4	25	37	38	8.0	6.6	4.8	0.7	0.6	0.5
57.3	39	38	43	8.2	6.8	7.6	0.5	0.5	0.4
70.5	40	43	37	8.8	7.4	5.8	0.5	0.5	0.5
86.3	11	21	31	8.9	8.5	9.8	1.8	1.0	0.6
45.4	51	25	19	8.9	7.4	8.7	0.4	0.8	1.0
68.5	35	35	27	9.5	8.4	6.5	0.6	0.6	0.7
53.5	24	30	28	9.6	8.2	6.5	0.7	0.7	0.7
62.4	64	53	39	10.1	7.8	6.8	0.3	0.4	0.5
85.4	19	17	16	10.4	8.7	6.4	1.3	1.4	1.9
60.2	2	1	1	10.6	8.9	6.9	6.7	6.9	8.5
39.4	53	31	23	10.6	8.9	8.2	0.4	0.6	0.9
68.4	23	23	18	11.4	10.2	8.4	0.8	0.9	1.1
78.6	36	48	56	11.5	9.4	8.1	0.6	0.4	0.3
37.7	8	8	11	13.1	11.2	9.4	2.4	2.1	2.3
38.1	14	9	13	13.2	10.6	8.8	1.5	2.1	2.0
44.1	55	22	93	13.6	10.5	11.0	0.3	1.0	0.2
51.2	3	5	3	14.3	12.6	10.8	4.5	3.9	4.7
38.0	27	36	26	15.6	13.3	12.4	0.7	0.6	0.7
36.0	307	65	17	15.7	7.6	6.9	0.0	0.3	1.8
80.5	60	27	22	15.8	13.8	10.9	0.3	0.7	0.9
38.4	78	28	20	16.1	14.8	14.5	0.2	0.7	1.0
39.5	62	58	36	16.2	12.5	9.7	0.3	0.3	0.5
36.1	17	11	5	16.4	15.7	15.3	1.4	2.0	3.4
79.1	38	32	33	16.5	13.6	11.6	0.5	0.6	0.6
54.5	29	41	25	18.2	16.9	15.4	0.7	0.5	0.7
39.2	13	13	8	18.3	16.6	14.8	1.6	1.8	2.5
81.5	18	14	7	18.9	16.1	13.7	1.4	1.8	2.6
81.4	21	16	9	19.0	15.2	12.4	1.1	1.5	2.4

Table 6—continued

Procedure Code	Frequency Rank			Average LOS			Percentage of Cases		
	1981	FY84	FY87	1981	FY84	FY87	1981	FY84	FY87
79.3	4	4	2	19.0	15.5	13.4	3.7	4.1	4.9
45.7	7	7	4	19.7	17.8	15.9	2.5	2.6	3.4
03.0	30	34	24	19.9	17.0	12.5	0.7	0.6	0.9
54.1	16	26	29	20.3	19.3	15.4	1.5	0.7	0.6
78.5	37	57	50	20.3	15.9	13.2	0.5	0.4	0.4
81.6	9	12	12	20.4	17.2	14.6	1.9	1.9	2.1
35.2	61	50	30	20.4	19.6	19.0	0.3	0.4	0.6
45.6	63	49	32	21.7	19.8	19.2	0.3	0.4	0.6
86.2	32	20	10	25.7	19.6	18.8	0.6	1.1	2.3
84.1	15	15	15	26.6	21.9	18.5	1.5	1.6	1.9

SOURCE: HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).
NOTE: Code listed if one of the top 40 codes in 1981, FY84, or FY87.

the increases occurred almost entirely between fiscal years 1984 and 1987. Most of these procedure groups had declining lengths of stay before fiscal year 1984.

The percentage change in length of stay did not vary considerably across procedure groups, as shown in Table 8. Procedure groups with long lengths of stay declined only slightly more rapidly than those with short lengths of stay. Procedure groups with the shortest lengths of stay in 1981 (i.e., less than five days) declined by 3.2 percent, whereas those with the longest lengths of stay (i.e., more than 15 days) declined by 4.2 percent.

THIRTY HIGHEST-VOLUME PROCEDURE CODES

Trends in volume and length of stay for the 30 highest-volume procedures in fiscal year 1987 are presented in Table 9.[7] These procedures accounted for about two-thirds of all Medicare surgical cases and also about two-thirds of all Medicare Part A charges by surgical cases in fiscal year 1987. As described in the Methods subsection, certain procedures presented analytical problems because of coding changes over time or frequent occurrence with a second surgery, so the findings for these procedures should be interpreted with caution. These procedures

[7]The highest-volume procedure in 1981 (13.1, intracapsular extraction of lens) does not appear in this table because its volume decline was so substantial it was ranked 98th in fiscal year 1987.

Table 7

VOLUME AND LENGTH-OF-STAY STATISTICS BY PROCEDURE GROUP

		Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
	Surgical Category	1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
001	Skull and brain—incision/excision	2909	4092	4557	25.0	21.6	18.5	−4.8**	−4.9**	−4.9**
					(0.4)	(0.3)	(0.2)	(0.6)	(0.6)	(0.3)
002	Skull and brain—other operations	749	1319	1569	23.2	20.5	17.8	−4.1**	−4.5**	−4.3**
					(0.6)	(0.5)	(0.4)	(1.1)	(1.1)	(0.6)
003	Spinal cord/canal	3373	4450	5895	19.6	16.8	13.0	−5.1**	−8.2**	−6.6**
					(0.3)	(0.2)	(0.1)	(0.6)	(0.5)	(0.3)
004	Cranial, peripheral nerves	4276	4598	1756	4.9	4.4	4.9	−3.3**	3.6**	0.1
					(0.1)	(0.1)	(0.1)	(0.9)	(1.2)	(0.6)
005	Sympathetic nerves, ganglia	928	754	423	19.6	15.9	12.0	−6.8**	−9.0**	−7.9**
					(0.5)	(0.5)	(0.5)	(1.2)	(1.5)	(0.7)
006	Thyroid/parathyroid glands	2438	2705	2948	9.2	8.1	6.5	−4.3**	−7.2**	−5.7**
					(0.2)	(0.2)	(0.1)	(0.9)	(1.0)	(0.5)
007	Other endocrine glands	179	320	379	18.1	16.2	14.9	−3.7	−2.6	−3.1*
					(1.1)	(0.6)	(0.7)	(2.3)	(2.0)	(1.3)
008	Eyelids	2843	2777	1017	3.8	4.0	6.5	1.4	17.7**	9.2**
					(0.1)	(0.1)	(0.3)	(1.4)	(2.2)	(1.0)
009	Lacrimal system	460	636	436	3.9	3.0	2.2	−7.8**	−10.8**	−9.3**
					(0.2)	(0.1)	(0.1)	(2.1)	(1.8)	(1.1)
010	Conjunctiva	112	113	71	5.5	4.4	5.5	−7.4	8.0	0.0
					(0.6)	(0.4)	(1.1)	(4.6)	(7.7)	(3.7)
011	Cornea	1645	2693	2549	4.8	3.9	2.8	−6.9**	−9.7**	−8.3**
					(0.1)	(0.1)	(0.1)	(1.0)	(0.9)	(0.5)
012	Iris, ciliary body, sclera, anterior chamber	4171	2593	1946	4.9	3.9	3.8	−7.3**	−0.9	−4.2**
					(0.1)	(0.1)	(0.1)	(0.9)	(1.1)	(0.5)

Table 7—continued

	Surgical Category	Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
		1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
013	Lens	68149	85675	8145	3.4	2.4	2.6	−10.8**	2.4**	−4.4**
					(0.0)	(0.0)	(0.1)	(0.1)	(0.8)	(0.4)
014	Retina, choroid, vitreous, posterior chamber	4165	5393	5534	5.6	4.5	3.5	−7.1**	−8.1**	−7.6**
					(0.1)	(0.0)	(0.0)	(0.5)	(0.5)	(0.2)
015	Extraocular muscles	309	290	90	3.9	3.1	2.9	−7.4	−2.4	−4.9
					(0.3)	(0.3)	(0.6)	(3.8)	(7.7)	(3.5)
016	Orbit and eyeball	1666	970	716	4.6	4.9	4.7	2.6	−1.3	0.6
					(0.1)	(0.2)	(0.3)	(1.5)	(2.1)	(1.0)
018	External ear	190	336	208	6.8	6.3	5.1	−2.6	−6.9*	−4.8**
					(0.6)	(0.6)	(0.3)	(4.0)	(3.4)	(1.7)
019	Middle ear—reconstructive operations	1177	1187	711	2.9	2.5	1.9	−4.6**	−9.1**	−6.9**
					(0.1)	(0.1)	(0.2)	(1.5)	(2.9)	(1.4)
020	Middle and inner ear—other operations	756	1043	829	5.8	5.2	5.0	−3.2	−1.5	−2.4
					(0.3)	(0.2)	(0.3)	(2.3)	(2.3)	(1.3)
021	Nose	1347	2023	1478	4.6	3.9	3.8	−5.6**	−0.9	−3.3**
					(0.2)	(0.1)	(0.1)	(1.5)	(1.5)	(0.9)
022	Nasal sinuses	760	1375	1424	5.6	4.8	4.4	−5.0**	−3.1	−4.0**
					(0.2)	(0.1)	(0.2)	(1.5)	(1.6)	(0.9)
024	Teeth, gums, alveoli—other operations	227	810	498	5.2	4.3	4.8	−5.9	3.5	−1.3
					(0.5)	(0.2)	(0.3)	(3.1)	(2.7)	(1.8)
025	Tongue	282	445	421	11.0	8.8	9.2	−7.4**	1.8	−2.9*
					(0.7)	(0.4)	(0.5)	(2.6)	(2.5)	(1.4)
026	Salivary glands/ducts	1127	1517	1623	6.2	4.6	3.5	−9.5**	−8.5**	−9.0**
					(0.2)	(0.1)	(0.1)	(1.1)	(1.2)	(0.6)
027	Mouth and face—other operations	1058	1514	1042	6.8	6.2	6.7	−2.9	2.6	−0.2
					(0.3)	(0.2)	(0.3)	(1.6)	(1.8)	(1.0)

Table 7—continued

	Surgical Category	Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
		1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
028	Tonsils and adenoids	254	327	308	6.9	6.4	6.5	−2.4	0.3	−1.1
					(0.5)	(0.5)	(0.6)	(3.6)	(3.9)	(2.0)
029	Pharynx	130	295	277	11.5	10.5	8.5	−3.0	−6.6*	−4.8**
					(1.1)	(0.8)	(0.5)	(3.9)	(3.0)	(1.8)
030	Larynx—excision	933	1858	1207	10.0	9.1	11.0	−3.3**	6.6**	1.6*
					(0.3)	(0.2)	(0.3)	(1.3)	(1.2)	(0.7)
031	Larynx and trachea—other operations	324	876	1306	15.8	24.5	30.3	15.7**	7.3**	11.4**
					(1.1)	(0.7)	(0.7)	(3.0)	(1.3)	(1.4)
032	Lung and bronchus—excision	1741	3718	4475	18.5	17.1	15.2	−2.6**	−3.9**	−3.2**
					(0.3)	(0.2)	(0.2)	(0.6)	(0.5)	(0.3)
033	Lung and bronchus—other operations	1249	1695	1153	16.5	15.9	16.4	−1.4	1.2	−0.1
					(0.4)	(0.3)	(0.4)	(1.0)	(1.1)	(0.6)
034	Chest wall, pleura, diaphragm, mediastinum	1511	2479	2581	14.7	14.1	13.2	−1.3	−2.4**	−1.8**
					(0.3)	(0.2)	(0.2)	(0.9)	(0.8)	(0.5)
035	Heart valves and septa	1647	2729	4202	19.9	19.5	17.9	−0.7	−2.9**	−1.8**
					(0.3)	(0.3)	(0.2)	(0.7)	(0.6)	(0.3)
036	Heart vessels	6442	14060	28677	16.5	14.7	12.4	−3.7**	−5.5**	−4.6**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.2)	(0.1)
037	Heart and pericardium—other operations	13796	17636	17604	12.5	10.5	9.2	−5.6**	−4.5**	−5.1**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.2)
038	Vessels—incision/excision/occlusion	15677	25625	24741	14.1	12.1	11.3	−5.0**	−2.3**	−3.7**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.1)
039	Vessels—other operations	11633	18962	24541	16.9	14.6	12.7	−4.8**	−4.4**	−4.6**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.2)
040	Lymphatic system	4025	5532	4738	12.2	10.6	9.7	−4.7**	−2.8**	−3.7**
					(0.2)	(0.1)	(0.1)	(0.6)	(0.6)	(0.3)

Table 7—continued

	Surgical Category	Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
		1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
041	Bone marrow and spleen	624	740	718	21.9	19.0	18.0	−4.7**	−1.7	−3.2**
					(0.7)	(0.5)	(0.6)	(1.3)	(1.4)	(0.7)
042	Esophagus	507	1363	1874	18.2	14.8	13.4	−6.6**	−3.4**	−5.0**
					(0.7)	(0.4)	(0.3)	(1.4)	(1.1)	(0.7)
043	Stomach—incision/excision	2378	3552	4228	23.2	20.2	17.7	−4.4**	−4.4**	−4.4**
					(0.3)	(0.2)	(0.2)	(0.6)	(0.5)	(0.3)
044	Stomach—other operations	4019	9864	5325	17.5	13.6	16.3	−8.1**	6.2**	−1.2**
					(0.2)	(0.1)	(0.2)	(0.5)	(0.5)	(0.3)
045	Intestine—incision/excision/anastomosis	16649	26873	30544	18.4	15.8	14.8	−4.9**	−2.1**	−3.5**
					(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)
046	Intestine—other operations	4659	5758	5691	19.3	17.7	15.9	−2.7**	−3.5**	−3.1**
					(0.2)	(0.2)	(0.2)	(0.5)	(0.5)	(0.2)
047	Appendix	2141	2362	2493	12.0	10.9	10.0	−3.2**	−2.7**	−2.9**
					(0.2)	(0.2)	(0.2)	(0.7)	(0.7)	(0.4)
048	Rectum and perirectal tissue	3488	5855	6281	15.8	14.0	13.3	−4.1**	−1.6**	−2.8**
					(0.2)	(0.1)	(0.1)	(0.5)	(0.4)	(0.2)
049	Anus	4743	5900	4623	7.8	6.5	5.1	−5.8**	−7.7**	−6.8**
					(0.1)	(0.1)	(0.1)	(0.5)	(0.6)	(0.3)
050	Liver	1220	1275	817	18.9	16.9	17.1	−3.7**	0.5	−1.6**
					(0.4)	(0.3)	(0.5)	(0.9)	(1.1)	(0.6)
051	Gallbladder and biliary tract	22294	26951	31129	14.8	13.2	11.3	−3.8**	−5.1**	−4.4**
					(0.1)	(0.1)	(0.0)	(0.2)	(0.2)	(0.1)
052	Pancreas	380	676	796	23.6	23.9	25.0	0.4	1.6	1.0
					(0.8)	(0.6)	(0.6)	(1.4)	(1.2)	(0.7)
053	Hernia repair	27082	31389	25808	7.6	6.3	4.9	−6.0**	−8.2**	−7.1**
					(0.0)	(0.0)	(0.0)	(0.2)	(0.3)	(0.1)

Table 7—continued

	Surgical Category	Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
		1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
054	Abdominal region—other operations	12896	13291	13218	18.8	17.0	14.6	−3.3**	−4.9**	−4.1**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.2)
055	Kidney	3381	5407	6223	19.3	16.8	15.1	−4.6**	−3.5**	−4.1**
					(0.2)	(0.2)	(0.1)	(0.5)	(0.4)	(0.2)
056	Ureter	1816	4102	4031	13.4	10.7	8.3	−7.2**	−8.0**	−7.6**
					(0.2)	(0.1)	(0.1)	(0.7)	(0.6)	(0.3)
057	Urinary bladder	13019	19460	16591	8.7	7.5	7.1	−4.9**	−1.7**	−3.3**
					(0.1)	(0.1)	(0.1)	(0.4)	(0.4)	(0.2)
058	Urethra	1913	2924	2879	8.5	7.0	6.0	−6.1**	−5.2**	−5.6**
					(0.2)	(0.1)	(0.1)	(0.9)	(0.9)	(0.5)
059	Urinary tract—other operations	973	1842	2022	11.3	9.8	7.1	−4.8**	−10.2**	−7.5**
					(0.2)	(0.1)	(0.1)	(0.7)	(0.6)	(0.3)
060	Prostate and seminal vesicles	35487	47189	51380	10.8	9.2	7.2	−5.4**	−7.9**	−6.7**
					(0.0)	(0.0)	(0.0)	(0.2)	(0.2)	(0.1)
061	Scrotum and tunica vaginalis	461	216	217	5.7	4.7	3.7	−6.1*	−7.9*	−7.0**
					(0.3)	(0.3)	(0.3)	(2.6)	(3.5)	(1.6)
062	Testes	2238	3003	3287	9.7	7.7	6.8	−7.3**	−4.2**	−5.8**
					(0.2)	(0.1)	(0.1)	(0.9)	(0.9)	(0.5)
063	Spermatic cord, epididymis, vas deferens	654	1324	682	5.8	4.4	3.3	−8.8**	−9.5**	−9.1**
					(0.2)	(0.1)	(0.1)	(1.5)	(1.5)	(0.8)
064	Penis	1853	2424	2223	6.4	5.3	4.6	−5.9**	−5.1**	−5.5**
					(0.2)	(0.1)	(0.1)	(1.2)	(1.2)	(0.7)
065	Ovary	981	1516	1735	14.4	12.7	10.7	−4.1**	−5.5**	−4.8**
					(0.3)	(0.2)	(0.2)	(0.9)	(0.8)	(0.4)
066	Fallopian tubes	130	145	132	8.6	5.7	5.6	−12.7**	−0.9	−7.0**
					(0.9)	(0.5)	(0.7)	(3.9)	(5.0)	(2.5)

Table 7—continued

	Surgical Category	Frequency[a]			Average LOS[b]			Av. Annual % Change[b,c]		
		1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
067	Cervix	1715	1462	664	6.2	5.6	6.6	−3.3*	5.3*	0.9
					(0.2)	(0.2)	(0.4)	(1.4)	(2.2)	(1.1)
068	Uterus—other incision/excision	6945	9555	10369	10.7	9.6	7.8	−3.3**	−6.6**	−5.0**
					(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.2)
069	Uterus and supporting structure—other ops.	5520	5322	1924	5.0	4.4	5.4	−4.0**	7.5**	1.6**
					(0.1)	(0.1)	(0.1)	(0.8)	(1.2)	(0.5)
070	Vagina	3500	4360	4366	8.9	7.6	6.2	−5.3**	−6.7**	−6.0**
					(0.1)	(0.1)	(0.1)	(0.5)	(0.5)	(0.3)
071	Vulva and perineum	941	1063	765	9.3	8.8	9.1	−1.7	1.0	−0.4
					(0.3)	(0.2)	(0.3)	(1.5)	(1.5)	(0.8)
074	Cesarean section	64	135	190	8.0	6.8	6.3	−5.0	−2.6	−3.8**
					(0.5)	(0.4)	(0.3)	(2.8)	(2.5)	(1.3)
076	Facial bones and joints	573	1067	962	10.3	7.9	7.8	−8.5**	−0.6	−4.6**
					(0.5)	(0.3)	(0.3)	(1.8)	(1.8)	(1.0)
077	Other bones—incision/excision/division	7570	10149	6790	9.9	8.4	9.0	−5.5**	2.4**	−1.6**
					(0.1)	(0.1)	(0.1)	(0.5)	(0.6)	(0.3)
078	Bones excluding facial—other operations	5637	5224	4332	15.7	12.5	10.8	−7.3**	−4.9**	−6.1**
					(0.2)	(0.2)	(0.2)	(0.6)	(0.6)	(0.3)
079	Reduction of fracture and dislocation	21911	30462	31563	18.7	15.3	13.1	−6.4**	−5.2**	−5.8**
					(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)
080	Joint structure—incision/excision	6186	10760	9031	11.2	10.4	10.6	−2.3**	0.6	−0.9**
					(0.1)	(0.1)	(0.1)	(0.5)	(0.4)	(0.3)
081	Joint structure—repair and plastic operations	23802	36203	43766	18.2	15.3	12.9	−5.7**	−5.4**	−5.6**
					(0.1)	(0.0)	(0.0)	(0.2)	(0.1)	(0.1)
082	Muscle, tendon, fascia—hand	1806	1981	970	4.4	3.6	3.4	−5.9**	−1.7	−3.8**
					(0.1)	(0.1)	(0.1)	(1.4)	(1.7)	(0.8)

Table 7—continued

	Surgical Category	Frequency[a] 1981	Frequency[a] FY84	Frequency[a] FY87	Average LOS[b] 1981	Average LOS[b] FY84	Average LOS[b] FY87	Av. Annual % Change[b,c] 81–84	Av. Annual % Change[b,c] 84–87	Av. Annual % Change[b,c] 81–87
083	Muscle, tendon, fascia—except hand	2941	4100	4306	9.0	9.0	8.3	−0.1	−2.7**	−1.4**
					(0.2)	(0.2)	(0.1)	(0.9)	(0.8)	(0.5)
084	Musculoskeletal system—other procedures	8064	11480	11894	25.2	20.9	17.7	−6.2**	−5.2**	−5.7**
					(0.2)	(0.2)	(0.1)	(0.4)	(0.3)	(0.2)
085	Breast	12415	15601	14621	8.4	7.3	6.1	−4.9**	−5.5**	−5.2**
					(0.1)	(0.0)	(0.0)	(0.3)	(0.3)	(0.2)
086	Skin and subcutaneous tissue	15522	19154	22882	14.5	14.7	16.1	0.4	3.1**	1.8**
					(0.1)	(0.1)	(0.1)	(0.4)	(0.3)	(0.2)
087	Biliary tract x-ray	95	275	158	15.2	12.8	10.3	−5.7*	−7.0**	−6.3**
					(0.9)	(0.6)	(0.7)	(2.3)	(2.4)	(1.4)
092	Implant/insert radioactive device	861	1225	1490	5.9	4.9	4.5	−6.0**	−2.7	−4.4**
					(0.2)	(0.1)	(0.1)	(1.6)	(1.4)	(0.8)

SOURCE: HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).

[a]Statistics reported only for categories with at least 25 observations in each year.

[b]Standard errors are in parentheses below the mean length of stay and average annual change.

[c]Two-tailed significance levels: * $0.05 \leq p \leq 0.01$; ** $p \leq 0.01$.

are identified in Table 9, and a detailed description of their particular problems is provided in Appendix A. Statistics for 29 of these 30 procedures between 1979 and fiscal year 1984 based on NHDS data are presented in Appendix C.

All 30 highest-volume procedures declined in length of stay from 1981 to fiscal year 1987. The average annual rate of decline was statistically different from zero for every procedure except 45.4, local excision of the large intestine. This procedure was one of only two procedures with an increase in length of stay between fiscal years 1984 and 1987.

The procedures with the greatest average annual declines, excluding procedures with coding problems, were:[8]

53.0	Unilateral inguinal hernia repair
85.4	Mastectomy
03.0	Exploration and decompression of spinal canal structures
81.4	Knee and ankle arthroplasty
60.2	Transurethral prostatectomy

The average annual rate of decline in length of stay ranged between 6.8 and 8.8 percent.

The procedures with the smallest average annual declines in length of stay were:

45.4	Local excision or destruction of lesion or tissue of large intestine
36.1	Bypass anastomosis for heart revascularization
35.2	Replacement of heart valve
38.4	Resection of vessel with replacement

Each of these procedures declined by less than 2 percent annually.

All 30 procedures, except laparatomy, had volume increases between 1981 and fiscal year 1984. Several procedures had large volume increases that continued until fiscal year 1987, including: heart surgeries (36.1, 38.4, and 35.2), hip replacements (81.5), other leg arthroplasties (81.4), intervertebral disc surgery (80.5), colon surgery (45.4), and wound debridement (86.2).

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[8]For procedure code 85.4, the proportion of cases having radical mastectomies declined from about 12 percent in 1981 to only 3 percent in fiscal year 1987. The average annual decline in length of stay for radical mastectomy cases, however, was the same as for other mastectomies—about 7.7 percent per year.

Table 8

PROCEDURE GROUPS, BY LENGTH OF STAY IN 1981

	Surgical Category	Average LOS			Change 81–87	
		1981	FY84	FY87	Av. Ann. Percent	No. of Days
19	Middle ear—reconstructive	2.9	2.5	1.9	−6.9	−1.0
13	Lens	3.4	2.4	2.6	−4.4	−0.8
08	Eyelids	3.8	4.0	6.5	9.2	2.7
09	Lacrimal system	3.9	3.0	2.2	−9.3	−1.7
15	Extraocular muscles	3.9	3.1	2.9	−4.9	−1.0
82	Muscle, tendon, fascia—hand	4.4	3.6	3.4	−3.8	−0.9
16	Orbit and eyeball	4.6	4.9	4.7	0.6	0.2
21	Nose	4.6	3.9	3.8	−3.3	−0.8
11	Cornea	4.8	3.9	2.8	−8.3	−2.0
04	Cranial, peripheral nerves	4.9	4.4	4.9	0.1	0.0
12	Iris, ciliary body, sclera	4.9	3.9	3.8	−4.2	−1.1
69	Uterus and supp structure—other	5.0	4.4	5.4	1.6	0.5
24	Teeth, gums, alveoli—other	5.2	4.3	4.8	−1.3	−0.4
10	Conjunctiva	5.5	4.4	5.5	0.0	0.0
22	Nasal sinuses	5.6	4.8	4.4	−4.0	−1.2
14	Retina, choroid, vitreous, posterior chamber	5.6	4.5	3.5	−7.6	−2.1
61	Scrotum and tunica vaginali	5.7	4.7	3.7	−7.0	−2.0
63	Spermatic cord, epididymis	5.8	4.4	3.3	−9.1	−2.5
20	Middle and inner ear—other	5.8	5.2	5.0	−2.4	−0.8
92	Implant/insert radioactive device	5.9	4.9	4.5	−4.4	−1.4
26	Salivary glands/ducts	6.2	4.6	3.5	−9.0	−2.7
67	Cervix	6.2	5.6	6.6	0.9	0.3
64	Penis	6.4	5.3	4.6	−5.5	−1.8
27	Mouth and face—other operations	6.8	6.2	6.7	−0.2	−0.1
18	External ear	6.8	6.3	5.1	−4.8	−1.7
28	Tonsils and adenoids	6.9	6.4	6.5	−1.1	−0.4
53	Hernia repair	7.6	6.3	4.9	−7.1	−2.7
49	Anus	7.8	6.5	5.1	−6.8	−2.7
74	Cesarean section	8.0	6.8	6.3	−3.8	−1.7
85	Breast	8.4	7.3	6.1	−5.2	−2.3
58	Urethra	8.5	7.0	6.0	−5.6	−2.5
66	Fallopian tubes	8.6	5.7	5.6	−7.0	−3.0
57	Urinary bladder	8.7	7.5	7.1	−3.3	−1.6
70	Vagina	8.9	7.6	6.2	−6.0	−2.8
83	Muscle, tendon, fascia, bursa—except hand	9.0	9.0	8.3	−1.4	−0.7
06	Thyroid/parathy glands	9.2	8.1	6.5	−5.7	−2.8
71	Vulva and perineum	9.3	8.8	9.1	−0.4	−0.2
62	Testes	9.7	7.7	6.8	−5.8	−2.9
77	Other bones—incision/excision	9.9	8.4	9.0	−1.6	−0.9
30	Larynx—excision	10.0	9.1	11.0	1.6	1.0
76	Facial bones and joints	10.3	7.9	7.8	−4.6	−2.6

Table 8—continued

	Surgical Category	Average LOS			Change 81–87	
		1981	FY84	FY87	Av. Ann. Percent	No. of Days
68	Uterus—other incision/excision	10.7	9.6	7.8	−5.0	−2.8
60	Prostate and seminal vesicle	10.8	9.2	7.2	−6.7	−3.7
25	Tongue	11.0	8.8	9.2	−2.9	−1.8
80	Joint structure—incision/excision	11.2	10.4	10.6	−0.9	−0.6
59	Urinary tract—other operations	11.3	9.8	7.1	−7.5	−4.2
29	Pharynx	11.5	10.5	8.5	−4.8	−2.9
47	Appendix	12.0	10.9	10.0	−2.9	−2.0
40	Lymphatic system	12.2	10.6	9.7	−3.7	−2.5
37	Heart and pericardium—other operations	12.5	10.5	9.2	−5.1	−3.4
56	Ureter	13.4	10.7	8.3	−7.6	−5.1
38	Vessels—incision/excision/occlusion	14.1	12.1	11.3	−3.7	−2.8
65	Ovary	14.4	12.7	10.7	−4.8	−3.7
86	Skin and subcutaneous tissue	14.5	14.7	16.1	1.8	1.6
34	Chest wall, pleura, diaphragm	14.7	14.1	13.2	−1.8	−1.5
51	Gallbladder and biliary tract	14.8	13.2	11.3	−4.4	−3.5
87	Biliary tract X-ray	15.2	12.8	10.3	−6.3	−5.0
78	Bones excluding facial—other operations	15.7	12.5	10.8	−6.1	−4.9
31	Larynx and trachea—other operations	15.8	24.5	30.3	11.4	14.5
48	Rectum and perirectal tissue	15.8	14.0	13.3	−2.8	−2.5
36	Heart vessels	16.5	14.7	12.4	−4.6	−4.1
33	Lung and bronchus—other operations	16.5	15.9	16.4	−0.1	−0.1
39	Vessels—other operations	16.9	14.6	12.7	−4.6	−4.1
44	Stomach—other operations	17.5	13.6	16.3	−1.2	−1.3
07	Other endocrine glands	18.1	16.2	14.9	−3.1	−3.1
81	Joint structure—repair and plastic operations	18.2	15.3	12.9	−5.6	−5.3
42	Esophagus	18.2	14.8	13.4	−5.0	−4.9
45	Intestine—incision/excision/anastomosis	18.4	15.8	14.8	−3.5	−3.6
32	Lung and bronchus—excision	18.5	17.1	15.2	−3.2	−3.3
79	Reduction of fracture and dislocation	18.7	15.3	13.1	−5.8	−5.6
54	Abdominal region—other operations	18.8	17.0	14.6	−4.1	−4.2
50	Liver	18.9	16.9	17.1	−1.6	−1.7
46	Intestine—other operations	19.3	17.7	15.9	−3.1	−3.3
55	Kidney	19.3	16.8	15.1	−4.1	−4.3
05	Sympathetic nerves, ganglia	19.6	15.9	12.0	−7.9	−7.6
03	Spinal cord/canal	19.6	16.8	13.0	−6.6	−6.6
35	Heart valves and septa	19.9	19.5	17.9	−1.8	−2.0
41	Bone marrow and spleen	21.9	19.0	18.0	−3.2	−3.9
43	Stomach—incision/excision	23.2	20.2	17.7	−4.4	−5.4
02	Skull and brain—other operations	23.2	20.5	17.8	−4.3	−5.4
52	Pancreas	23.6	23.9	25.0	1.0	1.4
01	Skull and brain—incision/excision	25.0	21.6	18.5	−4.9	−6.5
84	Musculoskeletal system—other	25.2	20.9	17.7	−5.7	−7.5

SOURCE: HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).

Table 9

VOLUME AND LENGTH-OF-STAY STATISTICS FOR 30 HIGHEST-VOLUME PROCEDURES IN FISCAL YEAR 1987

		Freq. Rank[a]			Frequency			Average LOS[b]			Av. Annual % Change[b,c]		
	Surgical Procedure	81	84	87	1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
060.2	Transurethral prostatectomy	2	1	1	30499	42831	47655	10.6 (0.0)	8.9 (0.0)	6.9 (0.0)	−5.6** (0.2)	−8.0** (0.2)	−6.8** (0.1)
079.35	Open reduction of fracture with internal fixation device—femur	4	4	2	8496	19599	21050	21.0 (0.1)	17.2 (0.1)	14.9 (0.1)	−6.4** (0.3)	−4.7** (0.2)	−5.6** (0.1)
051.2	Gallbladder removal	3	5	3	20377	24017	26102	14.3 (0.1)	12.6 (0.1)	10.8 (0.1)	−4.2** (0.2)	−5.1** (0.2)	−4.6** (0.1)
045.7	Large intestine—partial excision	7	7	4	11577	16398	18855	19.7 (0.1)	17.8 (0.1)	15.9 (0.1)	−3.4** (0.2)	−3.7** (0.2)	−3.6** (0.1)
036.1	Bypass anastomosis for heart revascularization	17	11	5	6276	12342	18848	16.4 (0.1)	15.7 (0.1)	15.3 (0.1)	−1.6** (0.3)	−0.8** (0.3)	−1.2** (0.2)
053.0	Unilateral inguinal hernia repair	5	6	6	15359	20136	15325	6.7 (0.0)	5.4 (0.0)	3.8 (0.0)	−7.1** (0.3)	−10.4** (0.3)	−8.8** (0.2)
081.5	Total hip replacement	18	14	7	6225	11006	14269	18.9 (0.1)	16.1 (0.1)	13.7 (0.1)	−5.2** (0.3)	−5.3** (0.2)	−5.2** (0.1)
039.2	Shunt or vascular bypass—other	13	13	8	7303	11289	13825	18.3 (0.2)	16.6 (0.1)	14.8 (0.1)	−3.4** (0.4)	−3.6** (0.3)	−3.5** (0.2)
081.4	Arthroplasty—knee and ankle	21	16	9	5034	9235	13370	19.0 (0.1)	15.2 (0.1)	12.4 (0.1)	−7.1** (0.3)	−6.7** (0.2)	−6.9** (0.1)
086.2	Wound debridement	32	20	10[d]	2959	6760	13114	25.7 (0.4)	19.6 (0.2)	18.8 (0.2)	−8.6** (0.6)	−1.5** (0.5)	−5.1** (0.3)
037.7	Pacemaker insertion	8	8	11	11169	13332	12982	13.1 (0.1)	11.2 (0.1)	9.4 (0.1)	−5.1** (0.3)	−5.7** (0.3)	−5.4** (0.2)

Table 9—continued

	Surgical Procedure	Freq. Rank[a] 81	84	87	Frequency 1981	FY84	FY87	Average LOS[b] 1981	FY84	FY87	Av. Annual % Change[b,c] 81–84	84–87	81–87
081.6	Other hip arthroplasty	9	12	12	8844	11548	11818	20.4	17.2	14.6	−5.5**	−5.3**	−5.4**
								(0.1)	(0.1)	(0.1)	(0.3)	(0.3)	(0.1)
038.1	Endarterectomy	14	9	13	7019	12963	11072	13.2	10.6	8.8	−7.0**	−5.9**	−6.5**
								(0.1)	(0.1)	(0.1)	(0.4)	(0.3)	(0.2)
057.4	Transurethral excision/ destruction of bladder tissue	10	10	14	8401	12481	10790	7.3	6.2	5.5	−5.5**	−3.7**	−4.6**
								(0.1)	(0.1)	(0.1)	(0.5)	(0.5)	(0.3)
084.1	Amputation—lower limb	15	15	15	6875	10176	10721	26.6	21.9	18.5	−6.3**	−5.5**	−5.9**
								(0.2)	(0.2)	(0.1)	(0.4)	(0.4)	(0.2)
085.4	Mastectomy	19	17	16	6008	8490	10507	10.4	8.7	6.4	−5.7**	−9.6**	−7.7**
								(0.1)	(0.1)	(0.0)	(0.4)	(0.3)	(0.2)
036.0	Removal of coronary artery obstruction	307	65	17[d]	93	1690	9812	15.7	7.6	6.9	−21.6**	−2.9**	−12.7**
								(1.4)	(0.2)	(0.1)	(2.5)	(0.8)	(1.4)
068.4	Hysterectomy—total abdominal	23	23	18	3843	5498	6187	11.4	10.2	8.4	−3.4**	−6.4**	−4.9**
								(0.1)	(0.1)	(0.1)	(0.4)	(0.4)	(0.2)
045.4	Large intestine—local excision/destruction	51	25	19	1681	4786	5810	8.9	7.4	8.7	−6.2**	5.6**	−0.5
								(0.2)	(0.1)	(0.1)	(1.0)	(0.7)	(0.5)
038.4	Resection of vessel with replacement	78	28	20	1011	4205	5792	16.1	14.8	14.5	−2.8**	−0.5	−1.6**
								(0.4)	(0.2)	(0.2)	(0.8)	(0.5)	(0.4)
013.5	Extracapsular lens extraction	12	2	21[d]	8278	40564	5595	3.0	2.3	2.5	−8.4**	3.3**	−2.8**
								(0.0)	(0.0)	(0.1)	(0.3)	(1.0)	(0.5)
080.5	Excision/destruction of intervertebral disc	60	27	22	1393	4451	5292	15.8	13.8	10.9	−4.4**	−7.4**	−5.9**
								(0.3)	(0.1)	(0.1)	(0.6)	(0.4)	(0.3)
039.4	Revision of vascular procedure	53	31	23[d]	1608	3789	5166	10.6	8.9	8.2	−5.8**	−2.7**	−4.2**
								(0.3)	(0.2)	(0.1)	(1.1)	(0.9)	(0.6)

Table 9—continued

	Surgical Procedure	Freq. Rank[a]			Frequency			Average LOS[b]			Av. Annual % Change[b,c]		
		81	84	87	1981	FY84	FY87	1981	FY84	FY87	81–84	84–87	81–87
003.0	Exploration/decompression of spinal canal structure	30	34	24	3016	3679	4817	19.9 (0.3)	17.0 (0.2)	12.5 (0.1)	−5.1** (0.6)	−9.8** (0.5)	−7.5** (0.3)
054.5	Lysis of peritoneal adhesions	29	41	25[d]	3029	3252	4068	18.2 (0.2)	16.9 (0.2)	15.4 (0.2)	−2.5** (0.6)	−3.1** (0.6)	−2.8** (0.3)
038.0	Incision of vessel	27	36	26[d]	3106	3663	3838	15.6 (0.3)	13.3 (0.2)	12.4 (0.2)	−5.2** (0.7)	−2.4** (0.7)	−3.8** (0.4)
068.5	Hysterectomy—vaginal	35	35	27	2796	3672	3825	9.5 (0.1)	8.4 (0.1)	6.5 (0.0)	−3.9** (0.4)	−8.4** (0.3)	−6.2** (0.2)
053.5	Other hernia repair—anterior abdominal wall	24	30	28[d]	3420	4118	3713	9.6 (0.1)	8.2 (0.1)	6.5 (0.1)	−4.9** (0.6)	−7.7** (0.6)	−6.3** (0.3)
054.1	Laparotomy	16	26	29[d]	6806	4612	3456	20.3 (0.2)	19.3 (0.2)	15.4 (0.2)	−1.5** (0.5)	−7.3** (0.6)	−4.4** (0.3)
035.2	Replacement of heart valve	61	50	30	1384	2476	3426	20.4 (0.4)	19.6 (0.3)	19.0 (0.2)	−1.3 (0.8)	−1.1 (0.6)	−1.2** (0.4)

SOURCE: HCFA (1981 MEDPAR, FY84 and FY87 PATBILL files).

[a]The rankings for procedure 79.35 are based on the frequencies for the entire 79.3x grouping, which were: 17,028 (1981), 25,336 (FY84), and 27,374 (FY87). Other statistics are for specific code 79.35.

[b]Standard errors are in parentheses below the mean length of stay and average annual change.

[c]Two-tailed significance levels: * $0.05 \leq p \leq 0.01$; ** $p \leq 0.01$.

[d]These procedures had classification problems. See Appendix A for further explanation.

The following procedures, excluding those with potential classification problems, declined in volume between fiscal years 1984 and 1987: unilateral inguinal hernia repair (53.0), pacemaker insertion (37.7), endarterectomy (38.1), and transurethral excision or destruction of bladder tissue (57.4). All of these procedures had large volume increases between 1981 and fiscal year 1984.

IV. CONCLUSIONS

Several important developments in health care delivery and financing occurred during the late 1970s and early 1980s that affected trends in hospital inpatient length of stay for Medicare patients. Perhaps the most important was the Medicare PPS. This system of fixed payments, based on DRGs, was proposed in late 1982, adopted by Congress in April 1983, and implemented in fiscal year 1984 (i.e., as of October 1983). PPS provides strong incentives for hospitals to improve their efficiency and reduce services. PPS was not the only important change in federal financing policy, however. During fiscal year 1983, before the start of PPS, hospitals were subject to a form of incentive reimbursement for Medicare patients adopted as part of the Tax Equity and Financial Recovery Act (TEFRA). TEFRA established limits on hospital payments after adjusting for hospital case mix using DRGs. TEFRA provided incentives for hospitals to improve their efficiency because they were allowed to keep a portion of the difference between their charges and the TEFRA limits.

In addition to these changes in financing, other concurrent factors affected trends in hospital length of stay. The two most important factors were increased use of outpatient surgery for certain procedures and increased use of complex surgical procedures because of diffusion of medical technology.

Our findings provide further insight into recent trends in length of stay, particularly for surgical cases. Historically, Medicare length of stay declined about 2.7 percent per year for medical cases, and about 1.9 percent per year for surgical cases, between 1967 and 1975. Between 1975 and 1981, length of stay declined at a somewhat slower rate (Gornick, 1982). Between 1981 and fiscal year 1984, however, we found average annual decreases in length of stay of 5.0 percent for medical cases and 3.8 percent for surgical cases. These rates of decrease are much greater than previous trends and appear to represent a strong hospital response to both TEFRA and PPS. Data from other sources (ProPAC, 1988; Guterman and Dobson, 1986) indicate that the largest declines in length of stay occurred between 1982 and 1984. Those findings, combined with our results, suggest that there was a strong anticipatory response to PPS, which was implemented in October 1983.

Aggregate length of stay for Medicare cases has remained relatively constant since fiscal year 1985. The average length of stay for medical

cases has remained relatively stable and has increased slightly for surgical cases. Our study demonstrates that these recent trends are the result of two opposing effects. Length of stay has continued to decline for most medical and surgical cases but inpatient case mix for surgical cases has shifted substantially toward longer-stay procedures. After adjusting for case-mix changes among surgical cases, length of stay continued to decline between fiscal years 1984 and 1987. Furthermore, the rate of annual decline after fiscal year 1984 was almost as large as the rate of annual decline between 1981 and fiscal year 1984. This finding indicates that, after adjusting for case mix change, PPS continued to have a strong effect on reducing surgical lengths of stay.

Geographic differences in average length of stay have not diminished. Average length of stay varied considerably across census region and between urban and rural areas in 1981. These differences remained in fiscal year 1987.

Our analysis of the 30 highest-volume procedures in fiscal year 1987 found that the percentage reductions in length of stay varied considerably across procedures. These procedures, which account for about two-thirds of all Medicare surgical cases, continued to decline in length of stay after fiscal year 1984.

Our findings support the overall conclusion that PPS has had a substantial and continuing impact in reducing one important component of hospital services, i.e., inpatient days. Another recent study found that the reduction in inpatient days during the first two years of PPS was partially offset by an increase in days in PPS-exempt units, such as rehabilitation hospitals (Newhouse and Byrne, 1988).

The ongoing influence of PPS on length of stay has been offset by a shift in case mix toward procedures that require longer lengths of stay. This shift in case mix is due to greater use of outpatient surgery and to advances in medical technology. Both of these factors tend to reduce short-stay admissions and to increase long-stay admissions, and neither effect is directly attributable to PPS. Use of outpatient surgery was increasing before PPS, and there is no evidence that PPS has delayed the adoption of new technologies. The rapid volume declines for certain procedures after fiscal year 1984, however, suggest that PPS accelerated the substitution of outpatient for inpatient surgery. This conclusion is supported by recent findings from other researchers (Leader and Moon, 1989).

Several policy concerns are raised by our findings. The persistent variations across geographic regions indicate that PPS has not led to more uniform practice patterns. The reasons for these continuing variations are not well understood, and their existence raises questions about the appropriateness of practice patterns in different geographic

regions. The increased use of long-stay procedures also raises questions about technology diffusion and the appropriate use of surgical procedures in the treatment of Medicare patients. These issues were beyond the scope of this study but will be the focus of a major federal research initiative adopted by Congress as part of the Omnibus Budget Reconciliation Act of 1989.

Rapid declines in inpatient lengths of stay and shifts in short-stay procedures to outpatient settings both raise possible concerns for the quality of care received by Medicare patients. One major study of the impact of PPS found declines in quality related to shorter lengths of stay for certain types of patients (Kahn et al., forthcoming). The shift toward outpatient surgery raises concerns because PROs, which were established to review the quality of care provided to Medicare beneficiaries under PPS, originally were required to review only inpatient care. Congress extended authority to PROs to review outpatient surgical cases as part of the Omnibus Reconciliation Act of 1986. There are continuing concerns about the adequacy of PRO review of outpatient surgery, however.

Reductions in hospital length of stay may also affect the amount of physician services provided to surgical patients. If physicians have reduced the number of follow-up visits they provide to Medicare surgical patients in response to reductions in hospital length of stay, changes in global fee payments to physicians may be necessary. For example, under the assumption that global fees include daily inpatient visits as part of the bundle of services provided to surgical patients, large decreases in surgical length of stay may mean that Medicare is paying for visits that are no longer being provided. Under these circumstances, reductions in global fees may be appropriate. Reductions in global fees may not be appropriate, however, if physicians have substituted posthospital visits for inpatient visits, or if they have increased the intensity of their inpatient visits. We did not directly examine these issues, but recent evidence indicates that physicians have not increased the amount of posthospital care for surgical cases under PPS (Rosenbach, 1988).

Surgical length of stay declined by an average annual rate of 1.2 percent between 1975 and 1977 (Gornick, 1982). The average annual rate of decline for surgical cases was 1.9 percent between 1979 and 1981 according to our findings. Neither of these rates were adjusted for case-mix change. Between 1981 and fiscal year 1987, the average annual rate of decline was 4.6 percent, holding case mix constant at the fiscal year 1987 level. These rates of decline can be used to calculate an estimated trend in average length of stay for Medicare surgical cases that started at about 16.1 days in 1975, declined to 14.4 days in 1981,

and reached 10.9 days in fiscal year 1987. If physicians provide daily visits during a hospital stay for surgery as part of their global fee, these trends may indicate a substantial reduction in visits since the early 1970s, when global fees were first developed. Furthermore, these trends suggest that revisions in global fee payments may be long overdue.

Appendix A

SURGICAL CODES WITH CLASSIFICATION PROBLEMS

	Surgical Procedure	Percent Primary Surgery[a]		Percent Change in Av. LOS[b]	
		FY84	FY87	FY84	FY87
86.2	Wound debridement	69	75	−3	−7
36.0	Removal of coronary artery obstruction	86	94	−13	−7
13.5	Extracapsular lens extraction	97	90	−1	−5
39.4	Revision of vascular procedure	83	81	−14	−17
54.5	Lysis of peritoneal adhesions	47	42	0	−2
38.0	Incision of vessel	74	70	−8	−9
53.5	Other hernia repair—anterior abdominal wall	84	78	−8	−16
54.1	Laparotomy	61	51	4	−6

[a]This is the percentage of all claims with this code when it is the first-listed operating room procedure.

[b]The percentage difference in mean length of stay between all occurrences and first-listed occurrences. A negative percentage change indicates that the mean length of stay was lower when listed as the primary surgery.

Code	Problem
86.2	This procedure often occurs with many other procedures. It occurs with 86.6 (free skin graft) about 12 percent of the time and with 84.1 (amputation of lower limb) about 8 percent of the time. When it occurs with 86.6, it is listed first only about half the time.
36.0	The ICD-9-CM system had major revisions in this category in fiscal year 1987. New codes for PTCA (percutaneous transluminal coronary angioplasty) (36.01 and 36.02) were added, so this procedure is not comparable across time. Note the extreme increase in frequency between 1981 (n = 93) and fiscal year 1987 (n = 9812) in Table 9. The great decrease in length of stay is also due to incomparability in this code.

13.5 This procedure was not a problem according to our definitions of first-listed frequency or change in length of stay. The data should be interpreted with caution for the following reasons, however. This surgery is rarely performed (e.g., only 5 percent of the time in fiscal year 1987) without another eye procedure during the same stay, usually with a lens insertion (13.7). Furthermore, there is a substantial discrepancy between the volume of cases with this procedure in the 1981 MEDPAR and 1981 NHDS files. This discrepancy appears to be due to coding differences in the two files. For example, the proportion of cases with a lens insertion as the primary surgery is substantially higher in the 1981 NHDS file than the 1981 MEDPAR file. The most reliable estimates of length-of-stay changes for lens procedures, therefore, are those in Table 7 and Appendix B, aggregated at the two-digit level.

39.4 This procedure occurs about 12 percent of the time with 39.2 (other shunt or vascular bypass). When it does occur, the length of stay is much higher, and 39.2 is listed first only about 60 percent of the time. Length of stay is also higher when 39.4 occurs in combination with 39.9 (other vessel operations)—about 4 percent of the time.

54.5 Length of stay is stable for this procedure, but it is the first-listed surgery less than half the time. It occurs in combination with many other procedures, most often with 54.1 (laparotomy)—about 10 percent of the time.

38.0 This procedure is a borderline problem by both criteria. It occurs about 12 percent of the time with 39.2 (other shunt), and about 5 percent with 84.1 (amputation of lower limb) or 38.1 (endartectomy).

53.5 This code occurs in combination with 54.5 (lysis of peritoneal adhesions) about 10 percent of the time and is often not the primary surgery. It also occurs with intestinal surgeries or gallbladder removal. In all these combinations, it has a higher length of stay.

54.1 This procedure has similar problems as 54.5 (lysis of peritoneal adhesions), and it is not considered the primary surgery about half the time. It occurs with 54.5 about 11 percent of the time.

Appendix B

VOLUME AND LENGTH-OF-STAY STATISTICS BY PROCEDURE GROUPS, NHDS DATA

Table B.1

VOLUME AND LENGTH-OF-STAY STATISTICS BY PROCEDURE GROUPS, NHDS DATA

		Frequency[a,b]			Average LOS[c]			Av. Annual % Change[c,d]		
	Surgical Category	1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
001	Skull and brain—incision/excision	3379	3481	4589	29.3	26.0	22.3	−5.9	−5.0	−5.4*
					(2.5)	(2.3)	(2.2)	(5.8)	(4.2)	(2.5)
002	Skull and brain—other operations	1222	1155	1867	17.5	20.6	18.1	8.5	−4.4	0.6
					(3.1)	(2.7)	(2.3)	(12.0)	(5.8)	(4.4)
003	Spinal cord/canal	2973	4948	5684	26.3	19.8	16.6	−13.2*	−5.6	−8.7**
					(2.8)	(1.3)	(1.2)	(5.4)	(3.1)	(2.3)
004	Cranial, peripheral nerves	5042	6440	4622	5.8	4.3	5.2	−14.4	6.8	−2.2
					(1.0)	(0.4)	(0.7)	(8.5)	(5.9)	(4.2)
005	Sympathetic nerves, ganglia	2093	1548	1089	21.7	18.4	13.8	−7.9	−9.1	−8.6*
					(2.3)	(2.7)	(2.3)	(8.4)	(6.8)	(3.7)
006	Thyroid/parathyroid glands	3444	2745	2498	9.7	9.6	7.2	−0.3	−9.4	−5.8
					(1.4)	(1.3)	(0.9)	(10.0)	(5.6)	(3.6)
008	Eyelids	3756	4014	2665	4.8	5.3	3.3	5.8	−15.0*	−7.2
					(0.9)	(0.9)	(0.4)	(13.5)	(6.1)	(4.3)
011	Cornea	1467	2727	2788	4.6	4.7	3.4	1.2	−10.6**	−6.0*
					(0.4)	(0.3)	(0.3)	(5.9)	(3.8)	(2.6)
012	Iris, ciliary body, sclera, anterior chamber	3409	3631	2859	4.3	5.1	3.8	9.1	−8.8	−2.0
					(0.4)	(0.7)	(0.4)	(8.6)	(5.0)	(2.6)
013	Lens	57772	81219	92044	4.1	3.3	2.6	−10.7**	−7.7**	−8.9**
					(0.1)	(0.1)	(0.1)	(1.4)	(1.4)	(0.9)
014	Retina, choroid, vitreous, posterior chamber	2940	3715	5153	6.2	5.6	4.9	−5.7	−3.9	−4.6*
					(0.4)	(0.3)	(0.3)	(4.2)	(2.7)	(1.8)
019	Middle ear—reconstructive operations	2178	1134	1790	3.7	2.6	2.2	−15.7	−5.7	−9.8*
					(0.9)	(0.3)	(0.2)	(10.8)	(4.6)	(4.7)

Table B.1—continued

	Surgical Category	Frequency[a,b]			Average LOS[c]			Av. Annual % Change[c,d]		
		1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
021	Nose	2072	2112	3252	4.8	5.5	3.9	6.7	−10.7	−4.1
					(0.9)	(1.2)	(0.5)	(15.1)	(7.7)	(4.3)
022	Nasal sinuses	845	1585	1846	7.1	9.4	4.5	15.6	−21.8**	−8.6
					(2.6)	(2.0)	(0.6)	(24.3)	(6.5)	(7.1)
024	Teeth, gums, alveoli—other operations	1095	1422	1247	6.8	4.8	8.1	−16.3	19.4	3.6
					(2.1)	(1.7)	(3.0)	(19.5)	(20.2)	(9.9)
026	Salivary glands/ducts	1480	1667	1161	5.9	5.7	4.7	−1.3	−6.3	−4.3
					(0.6)	(0.6)	(1.0)	(6.9)	(7.6)	(4.6)
027	Mouth and face—other operations	1714	1633	1744	5.4	5.7	7.2	3.0	7.6	5.8
					(0.9)	(0.9)	(1.7)	(11.6)	(10.3)	(6.0)
030	Larynx—excision	1700	2264	1734	11.1	13.9	10.8	11.7	−8.0	−0.6
					(3.1)	(2.4)	(1.7)	(18.4)	(7.1)	(6.4)
032	Lung and bronchus—excision	2960	3580	3457	22.5	20.6	16.5	−4.4	−7.1	−6.0*
					(2.2)	(1.7)	(1.7)	(6.0)	(4.0)	(2.6)
033	Lung and bronchus—other operations	2748	1436	2433	15.6	16.3	13.8	2.3	−5.5	−2.4
					(1.3)	(2.1)	(1.7)	(7.9)	(5.6)	(2.9)
034	Chest wall, pleura, diaphragm, mediastinum	2041	3015	2782	12.2	16.5	10.8	16.5	−13.1*	−2.3
					(1.5)	(2.1)	(1.4)	(10.3)	(5.2)	(3.5)
035	Heart valves and septa	1875	2776	2841	19.4	21.3	20.6	4.8	−1.1	1.2
					(2.3)	(1.9)	(2.2)	(7.9)	(4.6)	(3.2)
036	Heart vessels	5360	10598	15802	17.5	15.0	13.8	−7.5*	−2.6	−4.6**
					(1.1)	(0.6)	(0.5)	(3.5)	(1.8)	(1.4)
037	Heart and pericardium—other operations	19711	18634	22206	11.9	12.4	10.5	1.8	−5.2*	−2.5
					(0.5)	(0.5)	(0.6)	(3.1)	(2.2)	(1.4)
038	Vessels—incision/excision/occlusion	16713	23524	30849	14.5	16.2	12.5	5.6	−8.1**	−2.8*
					(0.8)	(0.7)	(0.5)	(3.6)	(1.8)	(1.3)

Table B.1—continued

	Surgical Category	Frequency[a,b] 1979	Frequency[a,b] 1981	Frequency[a,b] FY84	Average LOS[c] 1979	Average LOS[c] 1981	Average LOS[c] FY84	Av. Annual % Change[c,d] 79–81	Av. Annual % Change[c,d] 81–84	Av. Annual % Change[c,d] 79–84
039	Vessels—other operations	11132	14308	20850	17.0	16.1	14.3	−2.9	−3.8	−3.4*
					(0.9)	(0.9)	(0.7)	(3.8)	(2.4)	(1.4)
040	Lymphatic system	5546	5681	5797	13.4	12.0	9.2	−5.5	−8.5*	−7.3**
					(1.2)	(1.0)	(0.8)	(5.7)	(3.6)	(2.3)
043	Stomach—incision/excision	3096	3293	3271	22.0	24.8	19.8	6.1	−7.1*	−2.1
					(1.7)	(1.9)	(1.4)	(5.8)	(3.2)	(2.1)
044	Stomach—other operations	7318	8587	9332	15.6	15.7	13.9	0.3	−4.0	−2.3
					(1.1)	(1.0)	(0.9)	(4.7)	(2.9)	(1.8)
045	Intestine—incision/excision/anastomosis	18516	27174	34031	18.0	17.3	14.8	−2.0	−5.1**	−3.8**
					(0.6)	(0.5)	(0.6)	(2.3)	(1.5)	(1.0)
046	Intestine—other operations	6021	6779	7160	18.5	19.7	16.5	3.2	−5.7*	−2.3
					(1.2)	(1.3)	(1.1)	(4.6)	(2.8)	(1.8)
047	Appendix	2288	2884	3448	12.0	11.3	9.9	−2.9	−4.4	−3.8
					(1.9)	(1.0)	(1.2)	(8.8)	(4.9)	(3.8)
048	Rectum and perirectal tissue	6241	7062	5955	17.3	16.7	13.2	−1.9	−7.5**	−5.3**
					(1.2)	(1.0)	(0.7)	(4.5)	(2.6)	(1.7)
049	Anus	6030	7186	6210	8.6	8.7	6.7	0.7	−8.2*	−4.7*
					(0.6)	(0.5)	(0.6)	(4.7)	(3.2)	(2.1)
050	Liver	3523	3278	3912	15.5	15.4	13.5	−0.1	−4.4	−2.7
					(1.4)	(1.5)	(1.2)	(6.6)	(4.2)	(2.4)
051	Gallbladder and biliary tract	26178	28216	29970	16.6	15.7	13.0	−2.6	−6.0**	−4.7**
					(0.5)	(0.4)	(0.5)	(2.0)	(1.4)	(0.9)
053	Hernia repair	30835	33737	36132	8.0	7.3	6.6	−4.3*	−3.4*	−3.7**
					(0.2)	(0.2)	(0.2)	(2.0)	(1.5)	(0.9)
054	Abdominal region—other operations	15065	14912	14952	18.3	17.4	15.9	−2.5	−2.8	−2.7
					(0.7)	(0.9)	(0.9)	(3.1)	(2.5)	(1.4)

Table B.1—continued

	Surgical Category	Frequency[a,b]			Average LOS[c]			Av. Annual % Change[c,d]		
		1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
055	Kidney	4660	4392	7455	17.4	16.3	17.1	−3.2	1.6	−0.4
					(1.3)	(1.3)	(1.2)	(5.3)	(3.5)	(2.0)
056	Ureter	3612	3830	3892	15.3	12.4	9.8	−10.2	−7.4	−8.5**
					(1.5)	(1.1)	(1.1)	(5.9)	(4.5)	(2.7)
057	Urinary bladder	18394	19362	21575	9.4	9.2	7.8	−1.2	−5.3*	−3.7**
					(0.5)	(0.5)	(0.4)	(3.5)	(2.3)	(1.4)
058	Urethra	4051	4853	5735	8.5	9.4	8.9	4.7	−1.8	0.8
					(0.7)	(0.7)	(1.1)	(6.0)	(4.9)	(3.1)
059	Urinary tract—other operations	1362	1852	1924	11.9	14.7	8.9	11.0	−15.2*	−5.5
					(1.3)	(1.3)	(1.8)	(7.8)	(6.3)	(4.3)
060	Prostate and seminal vesicles	39899	47216	49039	12.3	11.7	9.7	−2.4	−6.1**	−4.6**
					(0.3)	(0.3)	(0.3)	(1.7)	(1.2)	(0.7)
061	Scrotum and tunica vaginalis	1082	1056	1024	5.4	6.6	5.6	11.1	−5.7	0.7
					(0.7)	(1.5)	(1.8)	(14.5)	(12.5)	(7.0)
062	Testes	2615	2188	3035	10.4	12.8	7.5	11.1	−16.3**	−6.3*
					(1.2)	(1.5)	(0.9)	(9.0)	(4.7)	(3.2)
064	Penis	1768	2451	3022	7.9	7.6	5.1	−2.5	−12.0**	−8.3*
					(1.5)	(0.8)	(0.6)	(10.6)	(4.6)	(4.0)
065	Ovary	1107	1819	1808	12.9	13.1	15.0	0.8	4.5	3.0
					(1.6)	(1.4)	(2.6)	(8.3)	(7.1)	(4.4)
067	Cervix	1221	1356	1688	7.6	11.8	4.3	25.0	−28.8**	−10.9**
					(1.0)	(2.7)	(0.6)	(16.5)	(6.2)	(3.4)
068	Uterus—other incision/excision	7693	10029	10296	11.8	10.9	9.1	−4.0	−5.6**	−5.0**
					(0.6)	(0.5)	(0.4)	(3.2)	(1.9)	(1.3)
069	Uterus and supporting structure—other operations	8581	9545	8782	6.2	5.1	5.0	−9.9*	−0.6	−4.4
					(0.5)	(0.4)	(0.5)	(4.7)	(4.1)	(2.4)
070	Vagina	4322	4560	4879	9.3	8.0	7.1	−7.7	−3.7	−5.3**
					(0.6)	(0.4)	(0.5)	(4.0)	(2.8)	(1.8)

Table B.1—continued

	Surgical Category	Frequency[a,b]			Average LOS[c]			Av. Annual % Change[c,d]		
		1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
071	Vulva and perineum	1473	1281	1634	14.7	14.4	8.0	−1.1	−17.9*	−11.6**
					(3.0)	(3.4)	(0.9)	(15.5)	(7.2)	(4.1)
077	Other bones—incision/excision/division	8136	10281	13080	10.7	11.2	7.9	2.3	−11.1**	−5.9**
					(0.9)	(0.9)	(0.6)	(6.0)	(3.3)	(2.2)
078	Bones excluding facial—other operations	8743	9916	9030	17.9	19.3	15.6	3.8	−6.8*	−2.7
					(1.0)	(1.1)	(1.2)	(4.1)	(2.9)	(1.8)
079	Reduction of fracture and dislocation	24311	23166	30479	19.6	19.1	14.5	−1.5	−8.6**	−5.8**
					(0.6)	(0.7)	(0.5)	(2.3)	(1.4)	(0.9)
080	Joint structure—incision/excision	6228	6953	10987	12.9	12.7	10.2	−0.8	−6.9	−4.5*
					(0.9)	(1.1)	(0.9)	(5.5)	(3.7)	(2.1)
081	Joint structure—repair and plastic operations	25894	31922	42314	19.9	17.7	14.4	−5.6**	−6.7**	−6.3**
					(0.6)	(0.5)	(0.4)	(1.9)	(1.1)	(0.7)
082	Muscle, tendon, fascia—hand	2969	2321	2238	2.4	3.6	3.9	22.6*	2.5	10.1**
					(0.2)	(0.6)	(0.6)	(10.7)	(7.7)	(3.8)
083	Muscle, tendon, fascia—except hand	3014	4209	4287	11.2	12.7	9.7	6.4	−8.8	−3.0
					(1.5)	(1.8)	(1.4)	(10.3)	(6.1)	(3.9)
084	Musculoskeletal system—other procedures	8654	9663	13217	25.0	28.0	21.5	5.8	−8.4**	−3.0
					(1.4)	(1.7)	(1.3)	(4.5)	(2.6)	(1.6)
085	Breast	15470	16479	18114	8.8	8.0	7.5	−4.7	−2.3	−3.2*
					(0.4)	(0.3)	(0.4)	(3.1)	(2.3)	(1.4)
086	Skin and subcutaneous tissue	23838	25965	26808	14.3	15.7	14.8	4.9	−1.9	0.8
					(0.8)	(0.8)	(0.8)	(3.8)	(2.4)	(1.5)

SOURCES: NHDS (1979, 1981, 1983, and 1984).

[a]Reported frequencies are weighted to be equivalent to the 20 percent sample of HCFA claims.

[b]Statistics reported only for categories with at least 25 unweighted observations in each year.

[c]Standard errors are in parentheses below the mean length of stay and average annual change.

[d]Two-tailed significance levels: * $0.05 \leq p \leq 0.01$; ** $p \leq 0.01$.

Appendix C

VOLUME AND LENGTH-OF-STAY STATISTICS FOR 30 HIGHEST-VOLUME PROCEDURES, NHDS DATA

Table C.1

VOLUME AND LENGTH-OF-STAY STATISTICS FOR 30 HIGHEST-VOLUME PROCEDURES, NHDS DATA

		Freq. Rank[a]			Frequency[b]			Average LOS[c]			Av. Annual % Change[c,d]		
	Surgical Procedure	1979	1981	FY84	1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
060.2	Transurethral prostatectomy	2	2	2	33283	40970	43114	11.9 (0.3)	11.6 (0.3)	9.5 (0.3)	−1.3 (1.9)	−6.3** (1.3)	−4.4** (0.8)
079.35	Open reduction of fracture with internal fixation device	4	5	5	15921	14021	19967	21.0 (0.7)	20.9 (0.8)	16.9 (0.6)	−1.9 (1.9)	−7.5** (1.6)	−5.3** (0.9)
051.2	Gallbladder removal	3	3	4	23079	25129	26463	15.6 (0.5)	15.1 (0.5)	12.1 (0.4)	−1.7 (2.1)	−7.0** (1.4)	−5.0** (0.9)
045.7	Large intestine—partial excision	9	7	7	11468	15879	16584	19.9 (0.7)	19.9 (0.7)	17.7 (0.7)	0.0 (2.4)	−3.8* (1.6)	−2.3* (1.0)
036.1	Bypass anastomosis	20	13	11	5278	10166	13977	17.0 (1.0)	14.6 (0.6)	14.7 (0.6)	−7.4* (3.3)	0.3 (1.8)	−2.8* (1.4)
053.0	Unilateral inguinal hernia repair	5	4	6	19004	20798	23486	7.3 (0.3)	6.3 (0.2)	5.5 (0.2)	−7.2** (2.5)	−4.2* (1.7)	−5.4** (1.0)
081.5	Total hip replacement	15	17	12	7057	8534	12752	20.4 (1.1)	17.6 (0.7)	15.5 (0.6)	−7.3* (2.9)	−4.0* (1.8)	−5.3** (1.3)
039.2	Shunt or vascular bypass—other	16	16	16	6812	8676	11137	19.8 (1.2)	17.2 (1.1)	17.2 (1.0)	−6.8 (4.2)	−0.0 (2.9)	−2.8 (1.7)
081.4	Arthroplasty—knee and ankle	19	20	17	5329	7109	10658	18.4 (0.8)	19.3 (0.7)	14.9 (0.5)	2.4 (2.9)	−8.3** (1.5)	−4.2** (1.0)
086.2	Wound debridement	22	19	18[e]	5158	7430	10548	25.2 (2.1)	26.1 (1.9)	22.0 (1.5)	1.8 (5.6)	−5.5 (3.1)	−2.6 (2.1)
037.7	Pacemaker insertion	6	8	8	14117	14850	16206	13.5 (0.6)	12.7 (0.5)	11.0 (0.6)	−3.0 (3.1)	−4.6* (2.3)	−3.9** (1.5)
081.6	Other hip arthroplasty	10	11	13	10420	12061	12399	23.0 (1.1)	19.9 (0.9)	17.0 (0.8)	−7.1* (3.0)	−5.2* (2.0)	−6.0** (1.2)

Table C.1—continued

		Freq. Rank[a]			Frequency[b]			Average LOS[c]			Av. Annual % Change[c,d]		
	Surgical Procedure	1979	1981	FY84	1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
038.1	Endarterectomy	14	12	9	7257	11310	15658	13.6	14.2	10.7	2.1	−9.0**	−4.7*
								(1.1)	(0.7)	(0.6)	(4.9)	(2.3)	(1.8)
057.4	Transurethra excision/ destruction of bladder tissue	8	9	10	12898	12794	15051	8.1	7.8	6.6	−2.3	−5.2	−4.0*
								(0.4)	(0.5)	(0.4)	(4.0)	(2.8)	(1.6)
084.1	Amputation—lower limb	13	15	14	7652	8983	11725	25.5	28.4	22.6	5.5	−7.2**	−2.3
								(1.5)	(1.7)	(1.3)	(4.5)	(2.6)	(1.6)
085.4	Mastectomy	12	18	19	7961	8324	9554	11.2	10.3	9.1	−4.2	−3.8	−4.0**
								(0.5)	(0.5)	(0.5)	(3.2)	(2.4)	(1.4)
068.4	Hysterectomy—total abdominal	26	23	27	4357	5747	5578	12.0	11.1	10.0	−3.9	−3.5	−3.7*
								(0.8)	(0.5)	(0.6)	(4.0)	(2.5)	(1.8)
045.4	Large intestine—local excision/destruction	31	24	21	3460	5145	7814	9.4	8.7	7.8	−3.7	−3.7	−3.7
								(1.5)	(1.0)	(0.7)	(9.1)	(4.6)	(3.5)
038.4	Resection of vessel with replacement	69	50	39	1523	2540	3752	14.3	18.3	14.8	13.2	−6.7	0.8
								(1.4)	(1.7)	(1.3)	(7.6)	(3.9)	(2.6)
013.5	Extracapsular lens extraction	34	6	1[e]	3074	18204	43143	3.9	3.0	2.6	−12.3**	−4.5	−7.7**
								(0.4)	(0.1)	(0.2)	(4.3)	(2.5)	(2.2)
080.5	Excision/destruction of intervertebral disc	39	66	37	2818	1787	3945	15.1	15.2	14.4	0.2	−1.8	−1.0
								(1.1)	(1.0)	(1.2)	(5.0)	(3.6)	(2.2)
039.4	Revision of vascular procedure	79	59	46[e]	1249	1991	3247	9.6	10.0	7.1	1.9	−10.7	−5.9
								(2.6)	(2.0)	(1.1)	(17.3)	(7.5)	(5.9)
003.0	Exploration/decompression of spinal canal structure	46	33	30	2317	3942	4671	28.3	18.7	16.7	−18.7**	−3.7	−10.0**
								(3.3)	(1.3)	(1.3)	(5.4)	(3.3)	(2.5)
054.5	Lysis of peritoneal adhesions	17	21	23[e]	5843	6196	6858	18.3	16.1	17.0	−6.4	1.9	−1.5
								(1.0)	(1.1)	(1.4)	(4.2)	(3.6)	(1.9)
038.0	Incision of vessel	44	36	32[e]	2431	3721	4484	18.1	22.7	14.1	11.9	−14.6**	−4.8
								(2.4)	(2.6)	(1.4)	(9.8)	(4.3)	(3.1)

Table C.1—continued

		Freq. Rank[a]			Frequency[b]			Average LOS[c]			Av. Annual % Change[c,d]		
	Surgical Procedure	1979	1981	FY84	1979	1981	FY84	1979	1981	FY84	79–81	81–84	79–84
068.5	Hysterectomy—vaginal	35	34	34	3037	3875	4386	10.7	9.9	7.6	−3.6	−8.3**	−6.5**
								(0.6)	(0.9)	(0.3)	(5.0)	(2.9)	(1.3)
053.5	Other hernia repair—anterior abdominal wall	24	25	29[e]	4653	4843	4875	9.0	9.0	8.7	0.0	−1.0	−0.6
								(0.7)	(0.5)	(0.6)	(4.7)	(3.0)	(2.0)
054.1	Laparotomy	21	26	43[e]	5176	4798	3485	20.0	18.7	15.0	−3.4	−7.0	−5.6*
								(1.4)	(1.4)	(1.9)	(5.0)	(4.7)	(2.8)
035.2	Replacement of heart valve	62	48	57	1712	2598	2556	19.9	21.6	20.1	4.2	−2.4	0.2
								(2.5)	(2.1)	(2.0)	(8.3)	(4.5)	(3.2)

NOTE: Code 36.0 is not listed for NHDS because unweighted frequency was less than 25.
SOURCES: NHDS (1979, 1981, 1983, and 1984).

[a]The rankings for procedure 79.35 are based on the frequencies for the entire 79.3x grouping, which were: 20,102 (1979), 18,602 (1981), and 26,412 (FY84). Other statistics are for specific code 79.35. Codes listed according to rank in the FY87 HCFA data.

[b]Frequencies weighted to be equivalent to the 20 percent HCFA claims file.

[c]Standard errors are in parentheses below the mean length of stay and average annual change.

[d]Two-tailed significance levels: * $0.05 \leq p \leq 0.01$; ** $p \leq 0.01$.

[e]These procedures had classification problems. See Appendix A for further explanation.

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